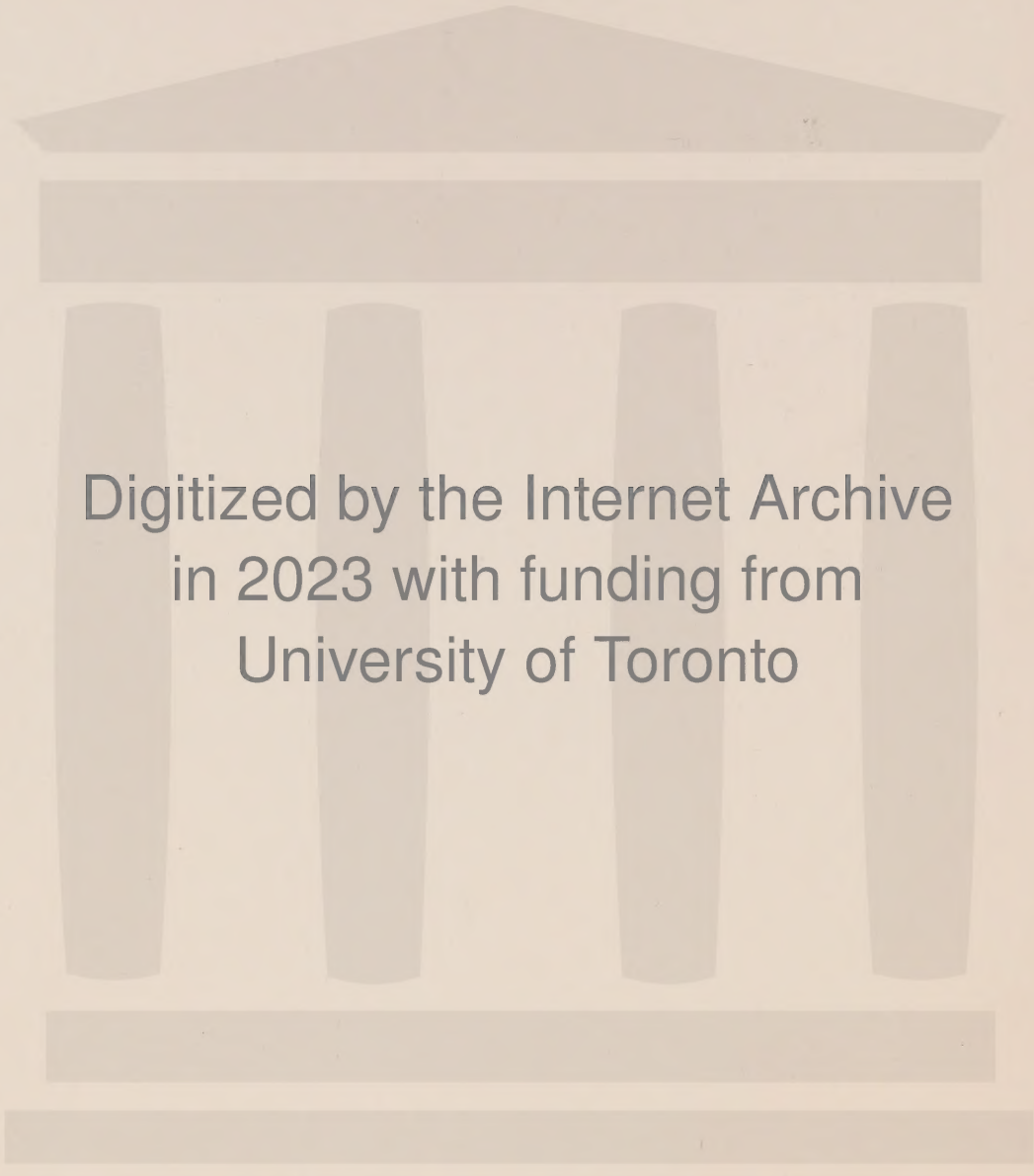
A SCIENCE POLICY FOR CANADA

Report of the Special Committee of the Senate on Science Policy

Chairman: The Honourable Maurice Lamontagne, P.C.

Volume 4

PROGRESS AND UNFINISHED BUSINESS



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* Other Senators who served on the Committee: The Honourable Frederick M. Blois, Chesley W. Carter, Carl H. Goldenberg, Orville H. Phillips and George C. van Roggen.

ORDER OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, November 30, 1976:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator McIlraith, P.C.:

That a Special Committee of the Senate, to be known as the Special Committee of the Senate on Science Policy, be appointed to consider and report on Canadian government and other expenditures on scientific activities and matters related thereto;

That the Committee have power to engage the services of such counsel and clerical personnel as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to sit during adjournments of the Senate and to report from time to time; and

That the Committee be authorized to print such papers and evidence from day to day as may be ordered by the Committee.

After debate, and—

The question being put on the motion, it was—

Resolved in the affirmative."

Robert Fortier,
Clerk of the Senate.

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Volume 4. Progress and Unfinished Business

PREFACE

Today it is widely recognized that science, technology, and innovation are of vital importance to the life of the country. For better or worse, they can make a major impact on economic growth and in many other areas of social life. In fact their importance to society as a whole is reflected in the development of science policy, whose object is the best use of science and technology. Yet in November 1967, when the Senate of Canada decided to establish a Special Committee on Science Policy, there was no appropriate basis for formulating government policy in this important area, nor any framework in the public or private sectors for discussing it.

There were no reliable figures on the size and distribution of the national effort devoted to science, technology, and innovation or even of the government's effort.* A small and powerless Science Secretariat within the Privy Council Office and a Science Council without staff were the only government agencies dealing with overall issues of science policy. The Canadian scientific and engineering community was divided into more than 100 isolated societies and associations too specialized to consider broad problems. Canadian scientific representation abroad was a mere extention of specialized government agencies and mainly limited to the United States and Great Britain.

THE FIRST INQUIRY

The committee's hearings began in March 1968 and ended in june 1969. In the process, it accumulated more than 12,000 pages of written briefs and oral evidence submitted by government departments and agencies, universities, industry, national associations, and individuals. Dr. Alexander King, an international expert on science policy, described our survey in the following

* When we discuss the national or the government science effort in this volume, we usually refer to R & D activities although occasional references are made to total scientific activities which also include technical surveys and data collection.

terms: "In no country has the legislative branch undertaken such a thorough and detailed job."[1]

The first volume of the committee's report, published in December 1970, reviewed three things: the historical evolution of Canadian science policy, the national science effort compared to other countries', and the evidence received from public hearings and briefs. The second volume, published in February 1972, described the targets and strategies needed for strengthening Canadian science, technology, and—most importantly—innovation. Volume 3, published in September 1973, completed the picture. It described the government organization that would be needed for formulating and implementing a more coherent national science policy.

The Committee found major deficiencies in Canada's scientific effort and science policy, deficiencies that were particularly disturbing because of our overall concern for the future of Canada. As the opening paragraph of Volume 2 put it: "The standard and quality of life in this country will be largely determined by the way in which the people and their institutions respond to the prospects and perils of the application of science and technology."

We made a comprehensive set of specific recommendations and supporting suggestions designed to develop and strengthen Canadian science, technology, and innovation. Following several years of analysis and debate, the committee ended its third volume with a call for immediate government action: "Let us make 1973 the year of decision on the broad and vital issues of science policy. A year of action, not reaction."

The government had not waited until 1973 before beginning to fill the gaps that our inquiry had identified. As a result of the guidelines for the preparation of briefs circulated by the committee in 1968, departments and agencies had to examine their research operations critically and several of them told us that they had at once begun to make improvements that would not have been initiated without such an examination. Our first inquiry also led to the preparation and publication of much more reliable statistics of the government science effort.

Early in our hearings in 1968, it became obvious that the central machinery for the formulation of science policy needed to be strengthened. As a first step in that direction, the Science Council became a crown corporation allowed to hire its own staff and in May of the same year the new director of the Science Secretariat was appointed Chief Science Advisor to the Cabinet. In Volume 1 we showed, too, that there was "a vacuum at the top." In June 1971 the government announced the creation of the Ministry of State for Science and Technology (MOSST).

The Canadian scientific and engineering community had never had the opportunity to discuss the broad issues of science policy. Our hearings

provided a public forum and launched a national debate on these issues. They also showed that the community was devided into a great number of scientific and professional associations, making the dialogue more difficult. We deplored these solitudes and at our initiative the Association of the Scientific, Engineering and Technological Community of Canada (SCITEC) was founded in January 1970.

In Volume 2 the committee recommended that the government's R & D needs be met as much as possible by industry and universities and that all intramural R & D activities be reviewed to see if they could be contracted out to the private sector. In February 1972 the government proclaimed the make-or-buy policy but limited its application to new mission-oriented research and development programs. Two years later the Cabinet extended the policy to provide for unsolicited proposals from industry to meet new government R & D needs.

The committee completed the first stage of its work with the publication of Volume 3 in September 1973. In February of the following year the then Minister of State for Science and Technology, the Honourable Jeanne Sauvé, announced that the government had decided to accept a series of important proposals made by the committee:

> The ministry was to have a stronger role in the formulation of new science-oriented policies.
>
> A special budgetary procedure would be developed for examining and approving departmental and agency science expenditure proposals, leading to the separate publication of a science budget.
>
> MOSST would be give the additional responsibility of reviewing and assessing science expenditure proposals before their final approval.
>
> The Natural Sciences Research Council and the Social Sciences and Humanities Research Council would be created to improve the support of research in universities.
>
> The terms of reference and composition of the Science Council would be extended.
>
> The industrial sector would receive priority attention in the development of additional thrusts.

In addition, substantial improvements were being made in Canadian scientific representation abroad and scientific and technological relations with other nations.

The committee was impressed by this quick government response. It promised a meaningful central machinery and a visible science budget, steps that we felt were essential for the formulation and implementation of a coherent science policy. With the basis solidly established, we anticipated that the Ministry of State for Science and Technology would become a dynamic agent of change and that action on our other recommendations would soon follow. However, our expectations were not realized.

THE SECOND INQUIRY

In the early summer of 1975 the committee took a quick look at the Canadian scene and found that the major deficiencies it had detected in 1970 still existed. We decided to seek authority from the Senate to determine if this first impression was correct and if it was, to inquire into the reasons. Why had there been no improvement? Had the committee's recommendations been rejected by the government, or had they been implemented badly or too late?

In a report presented to the Senate in July 1975 the committee recommended "that it be authorized to consider and report on Canadian government and other expenditures on scientific activities and matters related thereto." The committee made it clear, however, that in spite of the broad wording of those terms of reference, it wished to restrict its inquiry to three specific areas:

(1) The criteria and techniques used by the government, particularly the Ministry of State for Science and Technology, to review and assess scientific expenditures and programs.

(2) Implementation of the recommendations contained in the committee's report, especially in Volumes 2 and 3.

(3) The role of the Institute for Research on Public Policy in the area of futures research and the need for coordinated national networks of futures research and information.

The new mandate of the committee was approved by the Senate in the same month. In September and October 1975 the chairman of the committee invited government departments and agencies and representatives of universities, industry, and national associations who had participated in the first inquiry to submit new briefs. Our hearings began in December 1975 and ended in May 1977. Government agencies and other groups that presented briefs and appeared before the committee are listed in Appendix B.

The committee wishes to thank all those who submitted views. Their contribution to our work has been valuable. However, we are not summarizing their presentations in this report as we did for our first inquiry. Because of its limited scope the evidence before us this time is not as voluminous and is therefore more readily accessible.

The inquiry confirmed our impression that the basic deficiencies of the national and government science effort detected by the committee in 1970 had not been corrected. This was partly because of the inflationary crisis, the recession, the anti-inflation program, and government financial austerity. But it had also taken more time than we had expected to implement the recommendations accepted in February 1974. This in turn delayed or blocked action on our other proposals.

A new period of government activity began when we launched our second inquiry. We see more than mere coincidence in this. Our new visit to the

government scene created a further impetus to implement other recommendations. Here are some of the more important proposals made by the committee in 1972 that have been accepted since the latter part of 1975:

> Create the Social Sciences and Humanities Research Council and the Natural Sciences and Engineering Research Council.
>
> Extend the make-or-buy policy to all government intramural scientific activities.
>
> Create industrial task forces to prepare plans designed to improve the technological performance and the innovative capacity of manufacturing industries.
>
> Consolidate grants programs to encourage R & D in Canadian industries with a more flexible multi-purpose program and a simplified administration.
>
> Improve the mobility of scientific personnel in government laboratories and encourage older researchers to take other jobs in the public service or in the private sector.
>
> Publish a science budget covering proposed science expenditures.
>
> Launch a special program of futures studies (which is being carried out by the Institute for Research on Public Policy) and establish mechanisms to plan and co-ordinate futures research within the public service.

Other recommendations made by the committee have also been implemented or are being put into effect. We are convinced that this second inquiry has already proved to be most useful.

When our public hearings began our first witness was the Honourable C. M. Drury, then Minister of State for Science and Technology. In his opening statement he said:

> I have been most impressed by the record of performance of your committee . . . No one can doubt the thoroughness with which you approached your task. I think it is fair to say that no other investigation of science policy anywhere in the world has equalled that carried out by your committee. Your report has constituted a significant background to all discussions of science policy matters, and its influence will continue to be felt not only in Canada but, I suspect, also internationally.[2]

Our last witness was the present Minister of MOSST, the Honourable J. H. Faulkner, who stated in his opening remarks:

> This is my first meeting with the committee which, if I may say so, has been one of the outstanding success stories of parliamentary committees. I do not say that gratuitously. I happen to believe that not only has the committee made a profound impact on the development of science policy with government . . . but outside . . . I think it has been viewed . . . as a landmark of political awareness, if you like, of the role of science and technology in Canada.[3]

THE NATURE OF THIS VOLUME

This last volume of our report is completely different from the three previous ones. The terms of reference were limited to three specific areas. Given this restricted mandate we did not feel authorized to open up new science policy issues. That is why this volume contains few specific new proposals.

It was probably the first time that a parliamentary committee was asked to return to the scene of its main inquiry and find out through public hearings to what extent its previous recommendations had been implemented. We now realize that for issues as complex as those involving science policy such re-examination may be a very worthwhile exercise. This is a distinct advantage that parliamentary committees have over royal commissions, which disappear after presenting their reports.

The committee expected that its initial proposals would meet resistance. Donald A. Schon contends that the typical response to a demand for change is minimal compliance. This reaction, he says, "is particularly effective where those pressing for change cannot distinguish significant from token compliance, or can muster their forces only for an initial assault."[4] The effects of our second assault bear this out.

The present volume develops two main themes. The first one is delayed progress. If the government had been quicker and more efficient in implementing the recommendations it had already accepted, we would not have to deplore the situation existing today, although the lack of funds would have remained critical. While we regret these delays, we acknowledge that substantial progress has been made, especially since 1976. The government is now much better placed than it was in 1972 to develop a science policy that responds to national goals and needs.

The second theme, our main message, is that a good deal must still be done. We recognize that the target we had proposed for the national R & D effort—2.5 per cent of GNP by 1980—has become unrealistic. With this exception, the views presented to us during our second inquiry have convinced us that most of the recommendations made in 1972 and 1973 and not yet implemented by the government are still valid today. In certain cases, they are even more needed now than they were five years ago. We strongly recommend to the government that they should be implemented as soon as possible. Our last message is another call for quick, vigorous action.

NOTES AND REFERENCES

1. Alexander King, "The Lamontagne Report: An Erudite Approach to Science Policy Problems", *Science Forum*, April, 1972, p. 1.
2. *Proceedings of the Special Committee of the Senate on Science Policy,* First Session-Thirtieth Parliament, 1974-1976, Issue No. 1 dated December 3, 1976, p. 1:6.
3. *Proceedings of the Special Committee of the Senate on Science Policy,* Second Session-Thirtieth Parliament, 1976-1977, Issue No. 7 dated April 27, 1977, p. 7:6.
4. Donald A. Schon, *Beyond the Stable State,* Random House, New York, 1971, p. 50.

1

A SCIENCE POLICY BY ACCIDENT

Throughout the years in Canada, the stated science policy objectives of the government have not been those it implemented.

The main goal has always been the promotion of industrial development. The Order-in-Council setting up the Honorary Advisory Council (or, as it became popularly known, the National Research Council) in 1916 asked this new public agency, as its main function, "to select the most practical and pressing problems indicated by industrial necessities . . . for earliest possible solution."[1] More than 50 years later, in October 1967, the then Minister of Industry, the Honorable C. M. Drury, stated: "Our first obligation, therefore, is to ensure that technical innovation activity in our industry is brought to a competitive level in the shortest possible time." [2]

In spite of this persistent preoccupation of the government, successive studies have deplored the weakness of the industrial sector as an R & D performer and the disproportionately generous share of the science budget consumed by government laboratories. In 1970 the committee observed: "If we look at the international situation . . . the uniqueness of Canada's position becomes obvious. Canada is at the bottom of the list as far as R & D performed by industry is concerned, but at the top when it comes to the government and university sectors." [3]

Our comparisons were based on 1967 figures. Ten years later, in April 1977, the Minister of State for Science and Technology, the Honorable Hugh Faulkner, stated in the House of Commons:

> The government is aware that Canada's national research effort is less than half that of other industrialized nations, and that the distribution of effort among the three perform-

> ing sectors is the inverse of most other western nations, where typically industry performs 60 per cent of the national research effort, both internally funded and publicly funded. As I will explain shortly, the proposed budget reflects the government's intention to give greater emphasis to the research effort in industry and to design measures and policies that will encourage industry itself to take on greater responsibilities in this area.[4]

Thus the minister was restating in 1977 an objective that the Canadien government had pursued since 1916 but had failed to achieve.

How can one account for this continuing conflict between the formulation and the implementation of science policy? Obviously several factors were involved but the main explanation is fairly simple. Dr. E. W. R. Steacie, when president of the National Research Council in 1958, said: "We are, in fact, one of the few countries which has recognized the fundamental fact that the control of a scientific organization must be in the hands of sicentists." [5] And sicentists, left with the responsibility for implementing science policy, had their own conception of what it ought to be.

According to the model that the science managers began to develop in the 1920s, the government would help universities to train scientists and would build its own laboratories where the bulk of the research effort would be conducted, while industry would use the results of the research to solve its problems and to innovate. That model was systematically applied throughout the years and consequently there was little left in the science budget for R & D performed in the industrial sector.

In Volume 1 of its report, published in 1970, the committee underlined the gap between the formulation and the implementation of science policy and concluded that what Canada really had was a hidden science policy or, as it was described by the Secretary of Treasury Board during our first inquiry, a science policy by accident. Our basic message was to urge the government to develop a more coherent and rational policy. With the publication of Volume 2 in 1972, we began to put forward a comprehensive list of recommendations designed to produce such a policy.

EVOLUTION SINCE 1970

The committee has considered the evolution of Canada's science effort, including the government contribution, since 1970. As will be seen, the basic deficiencies underlined in Volume 1 are still with us today.

Table 1—Total gross expenditures on R & D (GERD) in Canada, 1970-76 and their relation to Gross National Product[1]

Year	GNP (millions $)	GERD (millions $)	% of GNP	GNP Deflator
				1971 = 100
1970	85,685	1,063	1.24	96.9
1971	94,115	1,191	1.26	100.0
1972	104,669	1,234	1.18	105.0
1973	122,582	1,345	1.10	114.7
1974	144,616	1,562	1.08	131.1
1975	161,132	1,732	1.07	145.2
1976	184,494	1,918[2]	1.03	158.9

[1] SOURCES: Economic Review, May 1977, Department of Finance; Statistics Canada; Education, Science and Culture Division.
[2] Estimate

Table 1 shows that gross expenditures on R & D expressed as a percentage of GNP have followed a slightly declining trend since 1972. Total R & D expenditures in current dollars have increased by about 80 per cent between 1970 and 1976 but most of this rise is attributable to inflation. If we use the GNP deflator to eliminate the effect of rising prices, we find that in terms of 1970 dollars GERD increased from $1,063 million in that year to roughly $1,170 million in 1976, or by about 10 per cent over the period. This is a very slow growth indeed, especially if we take the sophistication factor into account. It is probably true to say that the real intensity of the Canadian science effort was significantly smaller in 1976 than in 1970.

Table 2—Percentage of Gross Domestic Product devoted to GERD for 1973 and 1975 for selected OECD countries.[1]

Country	1973	1975
	%	%
United States	2.37	2.35
Germany	2.14	2.16
Netherlands	1.92	2.06
Japan	1.90	2.00[2]
France	1.79	1.86
Sweden	1.51	1.59
Canada	1.02	1.00

[1] SOURCE: OECD
[2] For 1974

We can observe, as we did in 1970, that on the basis of international comparisons, Canada still has a relatively low R & D intensity and that its effort is slightly declining while that of several other nations is rising. We

must conclude, therefore, that the country still lags far behind in the international technological race.

Table 3—Distribution of national R & D expenditures by sector of performance in Canada, 1970-1976[1]
(in percentages)

Year	Government	Business Enterprises	Universities and private non-profit institutions
1970	33.3	38.3	28.4
1971	32.3	39.4	28.4
1972	33.9	37.3	28.8
1973	34.5	37.5	28.0
1974	33.4	39.1	27.5
1975	32.3	40.0	27.7
1976	32.2	40.7	27.1

(1) SOURCE: Statistics Canada; Education, Science and Culture Division.

The distribution of National R & D expenditures by sector of performance has remained remarkably stable. The share of national R & D performed by this industrial sector is still very low when compared with what happens in other industrialized countries, where it exceeds 60 per cent in most cases. A specific comparison will illustrate this point. Canada and Scandinavia have approximately the same population and several other similarities. In 1973, while they had about the same number of researchers in universities, Canada had 9,000 more people working in government laboratories than Scandinavia but 20,000 fewer in the industrial sector. We have no reason to think the figures would be substantially different today.

Table 4—Distribution of national R & D expenditures by sector of funding in Canada, 1970-1976 [1] (in percentages)

Year	Government	Business enterprises	Universities and private non-profit institutions
1970	49.7	31.3	16.1
1971	49.1	31.7	16.8
1972	50.9	29.4	17.2
1973	51.5	29.4	16.6
1974	48.9	31.4	17.1
1975	46.9	32.8	17.3
1976[2]	46.9	33.8	16.9

(1) SOURCE: Statistics Canada; Education, Science and Culture Division.
(2) Estimates for 1976

Although the changes are slight, the government contribution has declined since 1973 and the share of financing provided by industry has increased in compensation. While this recent trend is an improvement, the government retains a dominant position as a provider of funds, which is not in line with the situation in other countries where the national R & D effort devoted to defence is relatively small, as it is in Canada.

Table 5—Federal expenditures on R & D (FERD) in the natural sciences by sector of performance, 1970-71 to 1977-78 [1]

(in percentages)

Fiscal Year	Intramural	Business enterprises	Universities	Total ($ millions)
1970-71	54.3	24.4	19.3	588.4
1971-72	55.6	22.9	19.4	618.4
1972-73	56.3	22.5	18.8	650.3
1973-74	55.6	24.0	17.7	721.1
1974-75	57.7	21.3	17.2	770.9
1975-76	54.1	22.9	18.0	777.3
1976-77	52.2	25.3	17.4	869.7
1977-78	53.3	22.7	18.2	929.3

[1] SOURCE: 1) Statistics Canada, Federal Government Activities in the Natural Sciences.
2) Main Estimates Science Addenda, 1977/78
Private non-profit institutions, foreign agencies, and others have not been included.

Federal expenditures on R & D in the natural sciences have increased by 58 per cent since fiscal year 1970-71 in current dollars. However, during the same period, the GNP price deflator rose by 64 per cent. On this basis, FERD in constant dollars has declined from $588 million to $567 million during those seven fiscal years.

It is difficult to detect any significant change in the distribution of federal R & D funds by sector of performance in recent years. Intramural activities still receive the dominant share. (In the current fiscal year the intramural share of total scientific activities funded by the federal government is higher still—63 per cent). Despite Mr. Drury's statement in 1967 that the government's first obligation was to ensure that technical innovation activity in industry was brought to a competitive level in the shortest possible time, the share of government R & D fuding received by the industrial sector has remained remarkably stable at around 23 per cent in the last seven years.

Table 6—Federal expenditures on R & D in industry, 1970-71 to 1977/78 (in percentages)

Fiscal Year	Make-or-buy	Other contracts	Grants	Total ($ millions)
1970-71	7.6	32.5	59.9	152.2
1971-72	14.5	18.6	66.8	159.5
1972-73	18.2	17.3	64.5	165.5
1973-74	20.7	17.2	62.1	196.6
1974-75	24.9	18.6	56.5	198.7
1975-76	27.8	21.5	50.6	215.1
1976-77	32.0	20.9	47.1	267.6
1977-78	39.7	22.8	37.5	263.7[1]

[1] This figure does not include a tax credit of 5 per cent worth between $35 million and $40 million.

SOURCES: 1) Statistics Canada, Federal Government activities in the Natural Sciences, 1963/64 to 1974/75.
2) Statistics Canada, Federal Government activities in the Human Sciences, 1970/71 to 1974/75.
3) MOSST/PRA/SCC Main Estimates Science Addenda, 1975/76 to 1977/78.

While R & D funded by government and performed by industry has increased by 73 per cent in current dollars since 1970-71, in constant dollars it has increased by only 6 per cent. During recent years, the increasing share of R & D contracts awarded to industry under the make-or-buy policy has been balanced by a substantial decline in the proportion covered by grants. In other words, the emphasis of government expenditure on R & D performed by industry has shifted from grants to contracts. This shift cannot be seen as improving technical innovation activity in industry. By their very nature, government contracts are generally less likely than grants to be directly related to successful innovation by industry.

Table 7—Federal expenditures on R & D in the natural sciences by department and agency, 1970-71 and 1977-78

Agency	($ million)		Percentages	
	1970-71	1977-78	1970-71	1977-78
Agriculture	63.1	112.4	10.7	12.1
A.E.C.L.	96.8	92.8	16.4	10.0
Communications	13.9	26.9	2.3	2.9
E.M.R.	34.7	66.0	5.9	7.1
Environment	70.9	121.2	12.0	13.0
I.T. & C.	72.2	77.6	12.3	8.3
M.R.C.	32.8	55.2	5.6	5.9
National Defence	53.7	74.9	9.1	8.1
N.R.C.	111.4	231.3	18.9	24.9
Others	38.0	70.4	6.4	7.6

SOURCES: (1) Statistics Canada
(2) MOSST, Main Estimates Science Addenda

The distribution of government R & D expenditures by department and agency tends to reflect the explicit and implicit goals of science policy. Among the main spenders, the National Research Council has been the only big gainer over the past seven years. It is reasonable to assume that a major portion of this gain was allocated to curiosity-oriented research carried out in universities and in NRC's own laboratories. Among the smaller spenders included in the residual category, we find the Canadian International Development Agency and the International Development Research Centre. Their R & D budgets rose from $1.4 million in 1970-71 to $18 million in 1977-78.

Among the main spenders, the big losers were Atomic Energy of Canada Limited and the Department of Industry, Trade and Commerce, whose main role is to reinforce industry's R & D capability through grants. The R & D budget of the Department of Health and Welfare in the natural sciences, included in the table with "others", remained the same in current dollars in the two years compared. As a result the share of the government R & D budget devoted to health, including the grants awarded by the Medical Research Council, declined from 9 per cent to 8 per cent.

These shifts mean that science policy has been putting more emphasis on curiosity-oriented activities in the physical sciences and on research related to international development but less on assistance to Canadian industry and on research related to health problems. Have these changes resulted from conscious government decisions or from a policy by accident? The committee inclines toward the second interpretation.

In summary, the national science effort and the government's part in it, as measured by the main parameters of R & D expenditures, have not significantly changed since the committee issued its first volume in 1970. Seven years later, we can still detect the same weaknesses, the same deficiencies, and the same imbalances. We made comprehensive recommendations that could have brought substantial improvements if they had been implemented early and vigorously. We now have to find out why an obviously undersirable status quo has been maintained for all these years.

THE VACUUM AT THE CENTRE

We had observed in 1970 that science policy decisions were taken in isolation by a myriad of government departments and agencies, often by the research scientists and engineers themselves, unguided by any external policy, priorities, or goals. We had a system in which supply created its own demand instead of responding to public need.

The Science Council of Canada, as an outside adviser, had no control over the system. The Treasury Board had the authority but lacked the time, staff,

and desire to exercise it properly. It played a negative role and could no more shape science policy than a bank manager vetting company requests for loans could shape industrial policy.

Thus it was impossible for an overall science policy to operate and to complement, correct, and integrate specific policies. There was a vacuum at the centre of the decision-making mechanism. Science policy was more a product of accident and force than of reflection and choice.

The committee found that deficiency deplorable and clearly indicated in Volume 1 that the vacuum had to be filled by a new department or ministry. In June 1971 the government announced the creation of the Ministry of State for Science and Technology (MOSST). This quick response was encouraging. A necessary though not sufficient first step had been made.

The ministry was given broad terms of reference and made responsible for the overall formulation of policy and the co-ordination of government programs and activities in the area of science and technology. In practice, however, it was expected to be chiefly a service agency to departments, to assist them in the preparation of their scientific programs. This advisory role did not seem any more adequate than that of the defunct Science Secretariat.

The committee had therefore to criticize MOSST's terms of reference in Volume 3, published in 1973. They did not give the ministry enough power to change the orientation and content of science policy. In our opinion, MOSST could play no useful role if it had to depend on the voluntary co-operation of departments and agencies, all of them naturally jealous of their prerogatives. We proposed a special budget procedure under which departments and agencies would prepare their proposed scientific expenditures separately from their main estimates and would be required to submit them directly to MOSST for review and assessment before they could be finally approved.

Under this procedure, departments and agencies would have had to establish a dialogue with MOSST about their programs, well before the stage of formally submitting their annual expenditures for approval. Any responsible management, it seemed to us, would wish to discuss future programs at the earliest stage with the ministry that had the authority to review and assess the resulting expenditure requests.

The committee recommended a final stage in this process, one of particular interest to parliamentarians and the public: the publication of a well organized science budget. This would be published separately when the Main Estimates were tabled in the House of Commons. It would show the main purposes of proposed scientific programs and demonstrate the relation between R & D funds and the Canadian problems to be solved.

The government accepted the substance of our recommendations. Since the 1975-76 fiscal year, departments and agencies have been required to prepare separate science expenditure proposals. MOSST is now authorized to review and assess these proposals before they are finally approved and is

therefore in the decision-making arena. And the ministry has made a first attempt at publishing the science budget.

However, the committee's recommendations are not being implemented in a way that will produce the results required for improving Canada's national science policy. Dr. Maurice LeClair, MOSST's secretary, confirmed this when he appeared before the committee. He said the ministry received most of the scientific expenditures estimates at the same time as the Treasury Board Secretariat, which did not allow enough time to review and assess the programs properly. We learned later that only one-quarter to one-third of the projects were sent directly to MOSST. And there was still less time for the ministry to look at the overall picture and assess it in the light of government objectives and so help to shape the direction and content of science policy.

Mr. D. B. Dewar, MOSST's assistant secretary (Government Branch), said in April 1977 that the ministry was making such an assessment but he added "... I think I would say it was usually after the event, because the time frame in which we are producing the advice to the (Treasury) Board usually does not permit that on the line." [6] This kind of assessment "after the event" cannot help to correct deficiencies in the science budget before its final approval.

It has taken three years to develop the new budgetary procedure and it may be too early yet to appraise its ultimate impact. But the committee fears it will not produce satisfactory results as it is currently applied. The external assessment of departmental estimates will remain superficial and the science budget will be limited to a simple *a posteriori* consolidation of specific projects and will therefore not meet the objectives it should serve.

We are convinced that two specific suggestions made by the committee in 1973 should be implemented.

First, the committee still feels that science policy decision-making needs to be improved at the departmental level. Too often, top management does not have the time or the interest to systematically relate their scientific programs to the needs and mission of their department or agency. Hence research services tend to create their own self-serving demand. To correct a similar situation in Britain, Lord Rothschild recommended that each mission-oriented department or agency hire a science adviser who would be the chief executive responsible for R & D and who would work directly with top management to determine the R & D requirements of the departmental mission. [7] If the science adviser were required to maintain close liaison with MOSST, the ministry would be able to perform its review and assessment function more effectively. We strongly urged that step in 1973 but it was not taken. It should be now.

Secondly, we had proposed that departments and agencies should be required to submit estimates of their scientific activities directly to MOSST and at a date which permits examination and assessment by MOSST prior to

their submission to the Treasury Board along with their other estimates. The Committee still regards this step as essential if MOSST is to perform the job it is expected to do effectively.

When Mr. Faulkner appeared before the Committee in April 1977, he accepted these two proposals as "very sensible" and "good" suggestions.[8]

In 1973 the committee recommended separate publication of a science budget that would "give Parliament and the public a better idea than they now have of the size and distribution of the government's scientific activities."[9] In April 1977 MOSST issued its first attempt; a publication entitled *Federal Science Programs,* 1977/78.[10] This has proven to be most useful and we congratulate MOSST for having taken this initiative.[11] At the same time, we believe, with the ministry, that this publication should be considerably improved.

The document contains only three tables and three graphs presenting highly aggregated figures for proposed expenditures. The remainder of the report appears similar to the type of descriptive material found in the *Canada Year Book.* Fully detailed descriptions of science budgets are published in other countries. Publications such as *An Analysis of Federal R & D Funding by Function* published by the U.S. National Science Foundation and the descriptive science budget issued by the French government should serve as models for MOSST's publication.

The government's failure to act on two of our recommendations on the science budget is not the only reason why the decision-making process has not improved and why the orientation and content of science policy have not changed significantly in recent years. In Volume 3, the committee expressed doubts that MOSST's structure, organization, and staff would enable the ministry to fulfill its larger role effectively. We recommended that the government set up an external task force to review the ministry's organization. Almost two years later MOSST decided to conduct its own internal review, which led to a major reorganization lasting from May 1975 to March 1976. The delay in conducting this operation, the time devoted to it, and the internal problems it created certainly played a part in preventing the ministry from playing its role fully.

Moreover, in a little more than five years of existence MOSST has had four ministers and three secretaries, as well as other changes in top management. This rapid turnover has kept the ministry in the take-off position, which is hardly consistent with carrying out a complex mission.

MOSST has kept a low profile up to now. This was probably wise at the beginning, given its internal turmoil and the conditions under which it had to operate. But if it obtains greater authority and the needed stability, it should become more visible and provide real leadership.

The Science Council of Canada is another important element of the central machinery for science policy. The committee made a few minor

recommendations in Volume 3 designed to improve the council's composition and terms of reference. The government acted on some of these: it increased the council's full membership, abolished its associate membership, and extended its mandate to cover the social sciences.

From a brief from MOSST in December 1975, the committee learned that the government expected "that in the future the Council will concern itself more with public awareness of science and its implications for society."[12] During its recent inquiry, the committee detected that the council had already moved in this direction in two new series of publications and as a result of the new emphasis appeared to be devoting less attention to science policy issues.

The committee agrees that the Science Council has an important role to play in educating the public about the impact of science and technology on society. Canadians are facing crucial technological issues, especially those related to energy and the environment, and they need an impartial, enlightened assessment. The council will have to review its activities in this area to see how it might fulfil this vital task more adequately.

But the council also has an important mission to accomplish as an impartial observer, informed adviser, and constructive critic of science policy. Indeed, Dr. Claude Fortier, vice-chairman of the council, told the committee in May 1976 that the council had set up a special group to study research in Canada "in terms of strength, structures and policies".[13] Some of the council's reports now being prepared for publication are focused squarely on important policy issues. This renewed interest in science policy issues should be vigorously developed in the future.

In summary, we have to conclude that the vacuum at the centre of science policy decision-making has not been completely filled. The government accepted the substance of most of our proposals in this area, but delays, timidity, and omissions at the implementation stage partly explain why deficiencies in the national and the government effort related to science and technology that we noted in 1970 are still with us today. The hidden science policy will continue as long as the decision-making process lacks a dynamic and powerful centre to change it.

RESEARCH ON RESEARCH

In Volume 2, published in 1972, the committee said that a coherent science policy requires an empirical knowledge of the different types of scientific activities, a better understanding of the relationship between research, discovery, and invention, and an appreciation of the conditions leading to successful innovations. We said that greater effort had to be devoted to research on research, not only to improve science policy but also to develop

more efficient techniques of research management and to maximize national scientific and technological output.

By now, this view is being heard all over the world. But the committee found that this area of research had been neglected in Canada. We proposed that MOSST support a special program of studies to be administered by an authoritative external committee and carried out in universities. We believed the ministry should be responsible for the program because studies on research and innovation were directly related to its mission.

Instead the Department of Industry, Trade and Commerce launched the program, administered by an internal group rather than an outside committee. In five years $1 million was spent. The result, according to the I.T.C. brief presented to us in March 1976, was the production of 41 studies. Nevertheless, a senior official of MOSST told us that he was not aware of the program. We were not impressed by the distribution of the studies. Moreover, it was clear that the sponsoring department had no plan for the program. It merely responded to individual application for funds; it made no evalution of the studies. We have still not seen a summary of the results of this million dollars' worth of research!

Not surprisingly, the program left several important gaps. For instance, we have asked on several occasions what factors accounted for the great weakness of the R & D effort in the industrial sector. Several answers have been given, such as the unfavourable climate created by government policies or the domination of the Canadian economy by subsidiaries of foreign corporations. But the Minister of State for Science and Technology told us in April 1977that to his knowledge no large-scale, systematic survey was available on the real causes of this industrial weakness.[14] It is not too surprising that the government has spent hundreds of millions of dollars over the last 15 years to correct this situation without too much success.

Research management is related to research on research. In 1972 the committee deplored the scarcity of competent research managers in Canada. We recommended that MOSST support training programs in university centres located in the main regions of the country. In its December 1975 brief, the ministry informed us that it had sponsored a study at Queen's university to consider our proposal. As a result of the Queen's report, the Canadian Manufacturers' Association set up a training course on innovation management. Unfortunately, although this course has been offered for three years, not enough students have registered for the course to be actually given, perhaps because of the high fee.

Here we have two good examples of "dynamic conservatism" and of minimum or delayed reaction to the need for change. In the case of research on research, our proposal was accepted by the government but badly implemented by public servants. As for the training of research managers, implementation of the recommendation we made in 1972 is today still at the

planning stage. As a result, an important opportunity to improve Canadian research management remains in abeyance.

NATIONAL R & D TARGETS AND PLANNING

A series of conclusions in Volume 2 underlined the importance and unique role of the science budget and the need to attain the optimum level and distribution of the national R & D effort. The committee's views were founded on an observation that we had thought would be obvious to all: a low level of funding and a warped pattern of distribution of expenditure signals an ineffective science policy. Yet this section of the report has been deeply misunderstood or misrepresented.

We looked at the national effort in an international perspective by comparing Canada's research intensity (i.e. gross expenditure on R & D as a percentage of gross national product) to that of other industrialized countries. We believed that our research intensity should ideally be similar to that of other industrialized countries. We saw Canada's basic research effort beyond a certain indispensable minimum mainly as an international obligation, as a contribution to the international pool of free knowledge that should be comparable to the share of other advanced countries. We interpreted the Canadian effort devoted to applied research, development, and innovation in the context of an international technological race in which Canada had to participate in order to survive, as other industrialized countries have to. We still believe that these propositions provide a sensible approach to determining targets for expenditure on science and technology.

On the basis of international comparisons and other evidence, the committee proposed in 1972 that the national scientific effort reach 2.5 per cent of GNP by 1980. We further proposed that 10 per cent of that amount be devoted to basic research, 60 per cent to industrial applied research and development, and 30 per cent to social applied research and development. We never said that these targets had to be attained by any means, certainly not by wasting money to reach them. But we said that if the target level and distribution of national R & D expenditures could not be realized through the implementation of worthwhile projects, then this deficiency should become a cause of prime concern and action should be taken to correct it.

In our view, the targets should at least serve as guides in judging the current trends of the national scientific effort and determining the overall directions of science policy. They should be useful tests of performance and planning tools. In its December 1975 brief, however, MOSST rejected this concept, claiming that national problems and priorities were changing over the years and that a fixed GNP-related target for science was not meaningful over the long haul. The ministry rejected the concept of targets simply as a

result of a misinterpretation of our proposals. For us, targets were the mere quantitative expression of what ought to be the broad objectives of science policy—an approach found essential in other industrial countries.

Within this rather limited meaning, we still believe that it would be useful to have a medium-term quantitative goal indicating what should be the size of the national science effort under realistic circumstances. It is clear that the figure of 2.5 per cent of GNP proposed in 1972 to be attained by 1980 will not be reached. We now suggest a target of 1.5 per cent for 1982. As Table 2 indicates, other industrialized countries have already exceeded that figure. Thus, that goal is certainly not exaggerated if Canada is to join the international technological race while maintaining her contribution to the international pool of free knowledge. We believe it could be attained if real efforts are made to improve the technological performance of Canadian industry. We will have more to say on this topic in Chapter 3.

In 1972 the committee asserted that science expenditures were a long-term investment that should not be submitted to the fluctuations of short-term policies, particularly not to temporary cuts during periods of financial austerity. We pointed out that it was not easy to call back research teams that had been disbanded and that young scientists could be permanently lost to the national science effort if they could not participate in research projects upon graduation. We therefore recommended that the government adopt an overall plan for science and technology for the 1970's and that successive five-year plans be developed thereafter.

During our recent inquiry, MOSST told us that it had fully supported the idea of forward planning.[15] Moreover, in February 1974 M^me^ Jeanne Sauvé, then Minister of State for Science and Technology, announced that her ministry would from then on "be responsible for the development of a science policy framework against which individual policies could be viewed" and that a fully detailed display of the science budget "would be used for the evaluation of departmental and agency budgetary proposals for scientific activity"[16] The announcement was clearly in line with the committee's proposals, implying as it did that a plan would be prepared as the basis for the policy framework and budget evaluation.

During our recent inquiry, it soon became obvious that no plan had been prepared. Nor was there any sign of the policy framework or the science budget display. Moreover, MOSST's attitude seemed inconsistent. Could it fully support the idea of forward planning while rejecting the concept of targets—surely an indispensable planning tool?

The absence of planning and targets had obvious results. The government continued to treat scientific expenditures like all other non-statutory outlays and they were submitted to the same restraints and short-term considerations when the austerity program and controls were announced. Individual science budgets were severely restricted. In *Federal Science Programs 1977-78*

MOSST states that fiscal year 1977-78 is "the first year since 1970-71 that science expenditures have not declined relative to the estimates as a whole."[17]

While everyone agrees that R & D expenditures by Canadian industry are much too low, the policy of the Anti-Inflation Board has inhibited any rapid increase in companies' investment in R & D. R & D expenditures allowable as deductible expenses could not exceed the level attained during the base period. And the recession had forced a great number of firms to maintain those expenditures to a minimum during the base period.

Under the Industrial Research and Development Incentives Act (IRDIA), government grants averaging about $30 million a year were provided to encourage research by industry. The program was cut in the fall of 1975 as an austerity measure and the committee was told that the decision had been taken at the top political level without consultation with MOSST at the official level. Thus the sound long-term objective of strengthening industrial research in Canada was sacrificed to dubious short-term considerations.

So here is another major factor accounting for the fact that the Canadian science scene has not improved over the last five years. As long as the government treats its scientific expenditures and programs like its non-statutory outlays and programs and sacrifices them to the fight against inflation, the vital long-term requirements of scientific activities will suffer, and the consequences will be serious. In the absence of long-term plans and targets, of a rational policy framework and a science budget evaluation, the government will have a science policy by accident instead of a coherent policy. This was the committee's initial message in 1970. We repeated it in 1972 and 1973. We reaffirm it today.

In the Order-in-Council creating MOSST in 1971, the government rightly stated that "science and technology vitally affect the well-being of Canadians and the future of Canadian society as a whole". If this statement is to be taken seriously, science policy should get a much higher priority than it has received in recent years and MOSST should be given the internal stability and strength as well as the external authority it needs to carry out its important mission effectively.

Our main recommendations can be summarized as follows:

Government departments and agencies with a sufficient science budget should have a science adviser acting as liaison between top management and research services as well as between the department or agency and MOSST.

A government directive should be issued requesting departments and agencies to submit their science expenditures proposals directly to MOSST at a date which permits examination and analysis by MOSST prior to their submission to the Treasury Board.

The Ministry of State for Science and Technology should improve its annual publication *Federal Science Programs* to provide more detailed information about the distribution and the rationale of the science budget, the highlights of current success stories and of new scientific programs being launched.

The Ministry should prepare a science policy framework as promised in 1974, including a five-year plan, to serve as a basis for the annual review and assessment of the science budget. This plan should include priorities and a target of 1.5 per cent of GNP for the national science effort to be attained by 1982.

NOTES AND REFERENCES

1. Report of the Senate Special Committee on Science Policy, Vol. 1, *A Critical Review: Past and Present,* Ottawa, 1970, p. 27.
2. Ibid., p. 110.
3. Ibid., p. 128.
4. *House of Commons Debates,* Second Session-Thirtieth Parliament, 1976-1977, p. 4668.
5. Report, op.cit., p. 269.
6. *Proceedings of the Special Committee of the Senate on Science Policy,* Second Session-Thirtieth Parliament, 1976-1977, issue no. 7 dated April 27, 1977, pp. 7:28-29.
7. A Framework for Government Research and Development, London, H.M.S.O., 1971.
8. *Proceedings,* op.cit., p. 7:35.
9. Report of the Senate Special Committee on Science Policy, Vol. 3, *A Government Organization for the Seventies,* Ottawa, 1973, p. 658.
10. Supply and Services Canada 1977. Catalogue No. ST 21-3/1978.
11. Previously MOSST published an annual review, *Federal Scientific Resources.* This publication, which gave a very detailed presentation of scientific expenditures, will now be replaced by *Federal Science Expenditures*—the "Grey Book". The latter will be published at the same time as *Federal Science Programs*; it will be for the science policy specialist and will contain nothing but computer print-out charts.
12. *Proceedings of the Special Committee of the Senate on Science Policy,* First Session-Thirtieth Parliament, 1974-1975, issue no. 1 dated December 3, 1975, p. 1:71.
13. Ibid., issue no. 10 dated May 5, 1976, p. 10:6
14. *Proceedings,* Second Session-Thirtieth Parliament, 1976-1977, issue no. 7 dated April 27, 1977, p. 7:32.
15. *Proceedings,* First Session-Thirtieth Parliament, 1974-1975, issue no. 1 dated December 3, 1975, p. 1:52
16. News release issued on February 28, 1974.
17. *Federal Science Programs* 1977-1978, p. 7.

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THE EMERGING CRISIS IN THE UNIVERSITY AND GOVERNMENT SECTORS

The science budget directly determines the level and distribution of activities in government laboratories and to a large extent also in the university sector. Since 1973, austerity and the make-or-buy policy have frozen the level of expenditures in government laboratories, measured in constant dollars. The estimated man-years devoted to scientific activities in the government sector in 1977-78 will drop by 2.5 per cent.

This trend is in line with our recommendation of 1972 that financial and manpower limits be imposed on intramural R & D activities. We had, however, anticipated a much more rapid increase in the science budget, which would have caused the relative share devoted to government laboratories to decline significantly. This did not happen.

Moreover, we recommended that MOSST develop a program to increase the mobility of R & D personnel within the government and between universities, industry, and public agencies, with special emphasis on transfers from government to industry. It was only when he appeared before us in April 1977 that the Minister of State for Science and Technology, Mr. J. H. Faulkner, announced that the ministry had "recently started an examination of scientific manpower problems in the federal government largely in response to questions raised in earlier hearings of this committee."[1]

This five-year delay in implementing our recommendations, together with budgetary restraints, has had the most undesirable results on the age distribution of scientific personnel in the Public Service. Empirical evidence available to us in 1972 showed that by the age of 40 most scientists have given their best as active researchers. Immobility tends to produce its worst results in government laboratories, where isolation is greatest.

In this perspective, the case of the National Research Council probably typifies the situation in government laboratories. In its brief, presented in June 1976, NRC reported that the average age of its researchers had

increased from 35 years in 1953 to 44 in 1973 and that this average should be considerably lower: "It is widely held that the average age of research community should not only be stable, but also considerably lower than the present value for NRC researchers. Unless more young scientists and engineers can be recruited, it is unlikely that the average age can be reduced substantially."[2] NRC also stated that some of its scientific instruments were becoming obsolete and that with limited ability to purchase new equipment, it became more difficult to introduce new projects or to change the direction of existing programs.

Spending more money on older researchers working on old projects with obsolete equipment does not seem the ideal way to obtain the best results. We detect here the emergence of a crisis in government laboratories which could seriously affect the volume and the quality of their scientific output. Moreover, the immobility of scientific personnel in these laboratories means that young scientists have very few opportunities to start on a research career in the government sector. Research, to paraphrase Steven Rose, is left in the hands of elderly representatives of middle-aged disciplines. This does not augur well for the future.

The committee hopes that MOSST, in co-operation with the Treasury Board and the Public Service Commission, will give the highest priority to these personnel problems. If the situation described to us by NRC is typical of the government sector, it is urgent to take action.

Conditions affecting the university sector are probably even worse. Government assistance has increased about one per cent over inflation but has not increased in line with the economy as a whole (Tables 1 and 5). With more research opportunities and the demands for costlier equipment, the universities have been hard pressed.

The Science Council told the committee in March 1976 that Canada's capacity for basic and applied research could be destroyed within a few years. Dr. Claude Fortier, vice-president of the council, said: "We must nevertheless note that the financial constraints currently forced upon university research are seriously jeopardizing its performance and the continuation of the present tendency would even endanger its very survival."[3] He later indicated that Canada's capacity for basic and applied research could be destroyed in three years.[4] Dr. Fortier mentioned the breaking up of research teams, the decline in the morale of academic researchers, the small number of opportunities offered to young scientists to pursue a research career in universities, and the acute problem of the aging of university staff. Here again, in the university sector as in government, austerity budgets coupled with the immobility of personnel lead to an emerging crisis.

If Canada is threatened with the loss of a new generation of scientists and is left with aging researchers, this must be a source of serious concern to all

Canadians, the government especially. We hope that the group established by the Science Council in May 1976 will soon be able to identify the real dimensions of this crisis and make proposals to overcome it. We expect that the Canadian Committee on Financing University Research set up by the Minister of State for Science and Technology in November 1976 will also help to correct the situation. The committee believes that if the government has started earlier to move toward higher R & D targets and to deal with the problem of manpower immobility as we recommended in 1972, the crisis in the government and university sectors would not be as acute as it appears to be today.

IMPROVING THE FUNDING OF UNIVERSITY R & D

In Volume 2, the committee presented a series of recommendations designed to improve the organization, strategies, and priorities of university research funding. An important proposal dealt with the reorganization of the federal granting agencies, including the creation of separate councils for the physical sciences and the social sciences and humanities. Although the government announced early in 1974 that it had accepted our suggestions in essence, the legislation required to implement them was not approved by Parliament until June 1977.

We proposed a study of the likely requirements for scientific manpower in the 1970's leading to a thorough reappraisal of all the Canadian government's scholarship and fellowship schemes. We were worried then about growing imbalances between the supply and demand of Ph.D.'s in the physical sciences and engineering and wanted to make sure that government assistance programs were not responsible for surpluses or shortages. MOSST told the committee in December 1975 that after the 1976 census the ministry and Statistics Canada would jointly sponsor a survey of highly qualified manpower, and that this should assist the granting councils in their review of their scholarship and fellowship programs.

The committee recommended that government support of basic research in universities should cover indirect as well as direct costs, on the grounds that much of this activity met an obligation on Canada's part to contribute to the international pool of free knowledge. The implementation of that proposal would certainly have helped universities. MOSST indicated in December 1975 that this specific issue and other problems associated with the government-university interface had been thoroughly investigated with university authorities and officials of the granting councils. There was no indication, however, that any decisions had been reached. We hope that the recently created Canadian Committee on the Financing of University Research will soon help to accelerate the process.

We suggest that government funding of basic research should emphasize quality rather than quantity, that the social sciences, multi-disciplinary efforts, and projects relevant to Canadian needs should get higher priority, and that the peer system should be improved. MOSST agreed with these suggestions but did not indicate how this support had influenced the priorities and strategies of government funding. Presumably MOSST's impact in this area will be more directly felt when the new councils are created, as the Inter-Council Co-ordinating Committee will be chaired by the secretary of the ministry.

In 1972, within the framework of an overall make-or-buy policy, the committee suggested a detailed an continuing review of all government intramural R & D programs to make sure that they corresponded to a real need and were contracted out, whenever possible to universities or industry. Early implementation of this contracting-out proposal could have greatly helped the university sector. The make-or-buy policy was proclaimed by the government in 1972 but was restricted to new mission-oriented R & D programs related to the physical sciences. It was only in April 1977 that the government indicated its intention of extending its policy to all intramural scientific programs and that the Minister of State for Science and Technology announced that it would undertake the review of current intramural activities we had suggested five years earlier.

After five years of indecision, the government has decided to act along the lines the committee suggested in 1972. With the new granting councils and their improved strategies, the government will soon have a better basis for decisions regarding university research. The recent extension of the make-or-buy policy will help the academic sector. The increase in funding for the granting councils in 1977-78 over 1976-77 will be about 12 per cent and will involve $12 million to compensate for inflation and $8 million in additional funds. This annual percentage increase should be continued during the next five years. Moreover, the government should include in its grants the indirect costs of R & D projects carried out in universities. Finally, universities should encourage their older researchers to increase their teaching load, thus leaving more opportunities for younger scientists to begin a research career. We are confident that such an overall program could prevent the crisis that is threatening the research performance of the university sector.

GOVERNMENT LABORATORIES AT THE CROSSROADS

Austerity, increasing costs including salaries, and the immobility and aging of personnel are not the only factors accounting for the impending crisis in government laboratories. Eventually the make-or-buy policy will have a much greater impact than all the other elements. The committee was told that in recent years most of the new mission-oriented R & D programs

initiated by government departments and agencies had been contracted out. The extension of that policy to current programs and to all scientific activities, and the detailed review of existing projects to determine whether they are justified, will certainly accelerate the shrinking process.

Implementing the contracting-out policy as the committee envisaged it in 1972 means that for the first time the government is to mount a systematic attack on the policy of developing the Canadian scientific effort mainly through government laboratories, which was adopted in the 1920's. This is certainly a move in the right direction, but the government must be fully conscious of its actions and their consequences and not fall into some new situation "by accident".

The decision has now been taken, at least implicitly, to cut seriously into government laboratories' intramural activities. This could eventually force some of them to operate inefficiently or even to close. It is not good enough to undertake a detailed review to cut unjustified projects and transfer others to the universities or to industry, as the government proposes to do. The government must look at the total picture and re-examine the rationale that justifies the existence of its laboratories. In 1972 the committee observed that there are intramural scientific activities that are indispensable to the success of government missions. In addition, government laboratories have a residual role of supplementing and complementing the university and industrial sectors. Those needs must be more clearly identified than they are at the moment.

Once this re-examination has been done, a reorganization plan must be prepared to provide for an improved division of labour and for multi-purpose laboratories that would allow more flexible programming as well as greater staff mobility. We proposed such a plan in 1972 and re-stated it in 1973.

We recommended that the National Research Council be transformed into an academy devoting all its activities to basic research and long-term applied research with no specific objective, that most of the intramural basic research be concentrated in this institution, and that a substantial portion of its work be performed at the request of government agencies and private firms on a fee basis. We justified the proposal on several grounds. Successive NRC presidents had always wanted to establish a great centre of excellence. If operational departments were to contract out most of their basic research activities, it would induce their research services to concentrate on their practical missions. The concentration of intramural basic and long-term applied research in one institution would provide the ideal climate for these types of activities and for a greater multi-disciplinary effort, while maintaining appropriate links between curiosity-oriented research and operational departments by means of contracts and personnel exchanges.

Some intramural mission-oriented research and development activities aimed at serving the manufacturing sector would be left after the full

application of the make-or-buy policy. The committee recommended that they should be integrated into another single institution, instead of being dispersed and isolated as they are at the moment. For this purpose, we proposed the establishment of the Canadian Industrial Laboratories corporation, which we described as another coherent multi-purpose institution, offering the advantages of specialization and integration, big enough to be viable, yet not so big as to be unmanageable. We also suggested that it should have a strong industrial represenation on its board and committees to remain responsive to the changing needs of industry and that it should be organized flexibly to ensure staff mobility.

The negative reaction of the government to these two major recommendations has been disappointing. On our second recommendation, the then Minister of State for Science and Technology, Mr. Drury, told us in December 1975 that the government was not satisfied that the benefits of such a large reorganization would justify the disruption and cost.[5] However, in May 1976 Mr. Jamieson, then Minister of Industry, Trade and Commerce, stated that he had been briefed on this proposal but had not yet reached any final conclusion on it.[6]

On our first recommendation Mr. Drury said that the decision had been taken not to "make radical changes to its [NRC] structure . . . but rather to encourage the agency to make a significant internal shift in emphasis towards support of Canadian industry and contribution to solution of specifically Canadian problems."[7]

In the light of that decision it was interesting to read the description of NRC's "redefined role" as given by its president, Dr. W.G. Schneider, in his annual report for 1974-75:

> The following activities will form the basis of NRC's future research program:
>
> i) basic and exploratory research;
>
> ii) long-term research, including selected areas of advanced technology and research directed toward problems of ongoing national concern;
>
> iii) industrially-oriented research and research services to industry;
>
> iv) research to provide technological support of social objectives;
>
> v) specialized major research facilities developed and operated as national facilities;
>
> vi) physical measurements and standards.[8]

Dr. Schneider went on to say that basic and exploratory research would constitute one-quarter to one-third of NRC operations. That does not include long-term research.

It is even more interesting to compare this redefinition of 1975 with the functions that a past president, Dr. E. W. R. Steacie, envisaged for NRC in 1958:

> As far as the National Research Council is concerned, the list [of activities] includes fundamental work, long-term applied work with no specific objective, work on specific industrial problems, short-term industrial problems (i.e. ad hoc investigations), investiga-

> tions for the services, consulting, testing, specifications and miscellaneous inquiries . . . In my view, at least as far as the National Research Council is concerned, long-term investigations, fundamental and applied, must constitute the major effort of the laboratories, if they are to keep the scientific reputation they have earned.[9]

The similarity between NRC's "redefined" and old roles is remarkable. The information NRC provided to the committee in May 1976 on its 1976-77 budget for intramural operations was also revealing. This budget was estimated at $63.7 million and distributed as follows: 25 per cent for basic and exploratory research, 23 per cent for research on long-term problems, 18 per cent for research in direct support of industrial innovation, 13 per cent for research to provide technological support of social objectives, 12 per cent for national facilities and 9 per cent for research and services related to standards.[10]

So 48 per cent of the budget or $31 million was devoted to what Dr. Steacie described as long-term investigations, fundamental and applied, and performed by two divisions of NRC, the biological science laboratories and the physical and chemical science laboratories. It is difficult to find in those figures the significant internal shift of emphasis anticipated by Mr. Drury. Is this another illustration of the gap existing between the formulation of science policy by the government and the implementation of that policy by science managers? Dr. Schneider seemed to indicate in May 1976 that "the significant *internal* shift of emphasis" would occur not through a change in NRC's intramural activities but through greater industrial participation in those activities or more grants to industry, presumably under the Industrial Research Assistance Program (IRAP).[11] We wonder if this is the kind of internal shift Mr. Drury had in mind.

We still believe that our 1972 proposal to transform NRC into a national academy concentrating on long-term investigations, fundamental and applied, makes sense. Its core already exists, in fact, since the physical and chemical science laboratories and the biological science laboratories already have a separate existence, each with its own group director. They had an operational budget of about $31 million in 1976-77. Of course, if the make-or-buy policy is applied extensively that budget will decline, which will mean an increased amount of unused capacity and low morale. But if most of what is left of the intramural long-term investigations presently carried out by operational departments and agencies is transferred, there will be enough prestigious work to make the new academy not only a viable centre of excellence but a great one, quite capable of contributing to the international pool of free knowledge and maintaining Canada's reputation.

NRC has reached the crossroads. Dr. Steacie feared that a significant internal shift of emphasis toward mission-oriented industrial research would "force real research out of the door." We share this fear and feel that pressure to make this shift will exist as long as NRC's role is ambivalent—as long as it is expected to contribute simultaneously to scientific discovery and

industrial innovation. NRC could be an important centre for scientific discovery, but to maintain this status it would have to remain too remote from the business world to contribute much to industrial innovation, at least in the start run.

In our view, the time has come to remove the ambivalence. Canada needs a visible national institution devoted to longterm scientific investigations to contribute to the advancement of knowledge in the world, to inspire the work done in universities, and to meet government requirements for long-term research. The academy could be a viable institution without really adding to the government's financial burden, as long as most of the curiosity-oriented research activities that should remain intramural are concentrated in it.

Dr. Schneider, in May 1976, based his opposition to this proposal on two arguments. First, a government laboratory devoted entirely to basic research would have a difficult time surviving in the long run because pressures would be exercised to have it do other things. Secondly, the feedback interaction between scientists doing basic research and those conducting applied research was essential. According to Dr. Schneider, this second consideration was more important than the first, but he conceded that such interaction did not require a single roof and could take place between different administrative units.[12] Moreover, as we had shown in 1973, our proposal for a national academy provided for the kind of organizational barriers between basic and applied research that had been established in the Bell Telephone Laboratories in the United States which, according to Harvey Brooks, are "widely regarded as the most successful and innovative technical organizations in the world . . . [and] as an appropriate model for what a federal scientific organization might become."[13]

The government must now decide whether it wants the National Research Council to become an academy mainly devoted to long-term research or a complex of industrial laboratories. In our view, NRC cannot excel in both missions, especially in the climate that will prevail in the future. The council could be forced to contract most of its basic research activities out to universities. We believe such a move would be both unrealistic and undesirable. On the other hand, the government has already implicitly decided, through the extension of its make-or-buy policy, that its intramural basic research activities will decline in the future. We feel that to keep the quality high while the level of effort shrinks will require concentration mainly in one institution. NRC is the only government agency qualified to accept that mission.

Intramural applied research and development activities designed to assist the manufacturing sector and the construction industry are at the same crossroads, facing the same shrinking process. At present these activities are dispersed in several government establishments. The Departments of the Environment, of Energy, Mines and Resources, and of Agriculture are engaged in such activities although their main research missions are quite

different. Other government agencies are also involved, including NRC's engineering laboratories.

This is the area of intramural scientific activities that is likely to be most seriously affected by the recent government decision to review all current scientific programs to see if they are justified and whether they should be transferred to the university or the industrial sector. It certainly is possible to carry out basic research programs successfully within government laboratories. To serve highly decentralized primary industries, to meet national requirements in natural resources, and to preserve the environment, it has often been essential to maintain intramural programs. However, it is not as easy for government laboratories to conduct industrial research that will successfully contribute to the innovation process in manufacturing industries.

All the empirical evidence shows that this research service is the least effective form of assistance that the government can offer to secondary industries. Several factors account for this. Very often the R & D programs selected by scientists and engineers isolated in government laboratories and remote from the business world do not correspond to industry's needs and problems. Scientific activities in those laboratories are often supply-push, but to lead to successful innovation industrial research must be demand-pull. Transferring the results of government R & D programs to individual firms raises serious difficulties. The not-invented-here syndrome, under which people reject inventions produced by others, is another major hindrance. The coupling of research results with management decisions is difficult enough when scientific programs are carried out within an individual firm; it becomes almost impossible when R & D activities take place in a remote government laboratory.

These factors explain why the old Canadian science policy model developed in the 1920's never really worked. The overall review of intramural scientific activities now being launched will undoubtedly provide another illustration of that failure. If the investigation is conducted seriously, it will lead to the recommendation that many existing intramural programs in this area should either be abandoned or transferred to industry if they are to achieve their purpose of promoting industrial innovations in Canada. That is the kind of situation the committee visualized in 1972.

We also anticipated then that it would be unrealistic to expect the government to suddenly abandon or transfer many of its intramural scientific activities serving the manufacturing sector. A sudden, drastic action would be too disrupting. We also believed that smaller government laboratories serving this specific purpose would always be needed.

It is in the situation now likely to prevail that our proposal to create a Canadian Industrial Laboratories Corporation (CILC) makes sense. The government now faces a dilemma: either it maintains a shrinking science effort, dispersed as it is, and accepts all the inevitable inconvenience of poor

performance, low morale, and immobility; or it implements our recommendation to integrate its remaining intramural programs serving manufacturing industries into a single complex of laboratories like the proposed CILC.

The CILC would provide a larger base of operation, more flexibility, and greater mobility. If the board and committees of the new corporation were mostly composed of representatives from industry, if the new agency reported to the Minister of Industry, Trade and Commerce, and if it were to operate partly on a fee basis like the provincial research councils, its activities would become more demand-pull and more responsive to real industrial needs.

In our view, the disruption this reorganization would cause would be much smaller than what would result from the patchwork that would be necessary to maintain reduced but dispersed programs. Moreover, we believe that the disruptions could be further reduced if the proposed integration were to take place gradually.

To start it off, we suggest that CILC should take over the engineering laboratories and industrial programs office now located in NRC and the forest products laboratories operated by Environment Canada. This would give the new corporation a core substantial enough to make it viable. Other intramural programs and activities could be assigned to it gradually whenever the detailed review now undertaken by the government revealed that such transfers were desirable.

CONCLUSION

The emerging crisis of the research effort in the university sector is caused mainly by inadequate public support and the immobility of researchers. The extension of the make-or-buy policy will mean that more funds out of the existing science budget will be available to universities. However, such transfers will be inadequate to surmount the crisis. We believe that research in universities corresponds to a basic long-term national requirement that should not be submitted to short-term austerity considerations. The science budget devoted to this purpose should be increased regularly in the future, at least, enough to take the inflation and sophitication factors into account. But even under these ideal conditions, financial resources will always be relatively scarce. Universities and the granting councils will have to develop strategies designed to increase the mobility of researchers in the academic sector and give greater opportunities to young and promising scientists to pursue a research career.

The crisis in government laboratories can also be seen as resulting from budgetary restraints and personnel immobility. We welcome the recent government decision to initiate a thorough study of this problem of immobili-

ty and we hope this investigation will lead to effective strategies to cope with it. However, the removal of budgetary restraints cannot be seen even as a partial answer to the mounting crisis in government laboratories.

The recent government decision to abandon its intramural scientific activities when they are not justified and to transfer the others to universities and industry whenever desirable means that it is now a deliberate policy to reduce the intramural science effort substantially. We hope the government will not try to maintain the dispersion and isolation of this reduced effort. The time has come to implement a major consolidation of what is left so as to preserve an optimum scale of operations, better morale, and greater flexibility and to ensure that the residual activities make the best possible contribution to scientific discovery and technological innovation. To achieve those objectives, the remaining intramural long-term investigations, fundamental and applied, should be concentrated in NRC, which would thus be transformed into a national research academy. In the same way, the residual applied research and development activities designed to serve the needs of secondary industry should be concentrated in a new multi-purpose institution, the Canadian Industrial Laboratories Corporation. If such a consolidation does not take place government laboratories will soon face a real crisis.

Thus, our main recommendations regarding future public support of the university sector and the reorganization of government intramural R & D activities are as follows:

The budget of the granting councils should increase by 12 per cent annually during the next five years as it did in the fiscal year 1977-78 to compensate for inflation and to support a greater research effort in the university sector.

R & D grants to universities should include the indirect cost of projects.

The extended make-or-buy policy, especially in the area of basic and applied research, should apply to the university sector as quickly as possible. NRC should be transformed into a multi-purpose national academy where most of the government intramural basic research and long-term applied research activities would be concentrated.

Another multi-purpose institution to be called the Canadian Industrial Laboratories Corporation (CILC) should be established where government intramural R & D activities serving the manufacturing sector would be consolidated.

NOTES AND REFERENCES

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3

THE PERSISTENT WEAKNESS OF THE INDUSTRIAL SECTOR

Since the beginning of the present century, the main dynamic factors of the Canadian economy have been the exploitation of natural resources and the primary processing of raw materials. Manufacturing industries relying mainly on imported technology have to a large extent merely responded to the needs of an expanding and protected domestic market. The service sector, while showing a dynamism of its own as a result of a greater division of labour, has been able to expand rapidly because it could respond to rising affluence without really being exposed to market forces or to international competition. This unique Canadian model, which showed features of both the developing and the developed worlds, has worked reasonably well until now.

However, most observers of the Canadian scene agree that the stock of natural resources, both renewable and non-renewable, will not be able for long to sustain the rate of exploitation experienced in recent decades. The rapid depletion of Canadian oil reserves is only the most dramatic development that has awakened Canadians in the last few years to the fact that their country was not endowed with boundless resources.

In Volume 2, the committee had also underlined the growing weakness of Canadian manufacturing industries as they were more dangerously exposed to international competition. This situation has since reached crisis proportions. The trade deficit in end products grew $3.6 billion in 1971 to $10.2 billion in 1976. If this trend continues, it will eventually create unbearable balance-of-payments difficulties, especially as net imports of oil are also bound to rise substantially. It will also have serious consequences on the level of employment.

It is obvious that the service sector cannot be the permanent prime mover of the Canadian economy. Thus, a more dynamic role must be developed for manufacturing industries if we want to achieve sustained and more balanced growth, to minimize balance-of-payments difficulties and bring unemploy-

ment to more acceptable levels. And yet to develop that role, the manufacturing sector cannot rely on higher tariff protection and low wages.

THE CANADIAN TECHNOLOGICAL GAP

To make a more dynamic contribution to the Canadian economy, manufacturing industries must be able to face international competition both at home and abroad. Is this an impossible objective for Canada? Various factors contribute to the weakening of the competitive position of Canadian industries, such as the size of the domestic market, lower productivity and higher labour costs. The consideration of these serious problems is beyond our terms of reference. However, other countries with high cost economies and a small domestic market, such as Switzerland, Sweden, Finland, the Netherlands and Denmark have reached that goal. Expert opinion is unanimous in recognizing that innovation is one of the key factors and that to be innovative, industry must have a critical mass of R & D activities geared to market opportunities.

In Volume 2 we quoted empirical studies showing the close causal relationship between R & D intensity and technological innovation, sales, and profits as well as overall economic growth and gains in productivity. Recent evidence confirms this relationship. The publication *U.S. Technology Policy* issued by the U.S. Department of Commerce in March 1977 claims that technological innovation was responsible for 45 per cent of the growth in the American economy between 1929 and 1969. In his report *Investment for Innovation* presented to MOSST in January 1977, Mr. Gordon R. Sharwood refers to other studies showing that R & D accounted for 40 per cent of the total increase in U.S. productivity over the years and that industry averaged a 30 per cent return on R & D spending, twice the rate companies were getting from other business investments.

In 1972 the committee deplored the weakness of the R & D effort and innovation performance of Canadian Industry. Since then, as the statistical tables presented in Chapter 1 show, the share of national R & D performed and funded by industry has increased slightly. In current dollars, R & D performed by industry rose from $460 million in 1972 to an estimated $781 million in 1976. This represents an increase of 70 per cent. The GNP price deflator rose by 51 per cent during the same period so real effort by industry increased 13 per cent in constant dollars.

However, Canada is still a long way behind other industrialized countries. In 1973, Canadian industry would have had to increase the total manpower engaged in R & D by about 20,000 to match the effort made by Scandinavia and by 40,000 to match the most advanced OECD countries. In 1975, R & D performed by Canadian industry amounted to $692 million while in

Switzerland, with a population less than a third of Canada's, the industrial effort was about $1 billion. On a per-capita basis, Swiss industry out-performed Canadian industry five or six to one in the field of R & D.

To be on a competitive level with most other advanced countries in 1976, Canada would have had to devote nearly 2 per cent of GNP to R & D activities and the share of that effort performed by industry would have had to be about 60 per cent. Canadian industry's effort would have reached $2.3 billion instead of the $780 million it actually spent. This is a measure of the gap that would have to be filled to bring Canadian industry to a competitive level of technological innovation activity.

In the absence of systematic studies, various explanations of the Canadian technological gap have been given. The main blame is often put on government policies, including declining tariff protection in a domestic market that is already restricted. It is also alleged that Canadian consumers have too great a preference for the products of foreign technology. Imports of technological innovations by Canadian producers, especially by subsidiaries of foreign companies, are seen as another important factor. While this technological dependency can be represented as a cheap way to profit from the R & D effort of other countries, it also means that the exploitation of those foreign innovations by Canadian producers occurs too late in the product cycle to give the lead time necessary to reach world markets.

Other factors also account for the low innovative performance of Canadian industry. Canada is one of the few countries in the world that did not have to innovate to reach affluence. In general, management has not developed the risk-taking mentality required for innovation. It does not look at R & D expenditure as a highly profitable investment but rather as a form of conspicuous consumption that business can afford when profits are high.

Fortunately this attitude is not shared by all firms. For instance, Robert Scrivener, the president of Northern Telecom Ltd. stated recently that his company was in the fastest changing business in the world and that to succeed in that business there was no choice but to be in the forefront of research and development. He announced that his firm had devoted $70 million to R & D in 1976 and was planning to spend between $200 million and $250 million annually in five years.

Canadian manufacturing industry suffers from other structural deficiencies that reduce its innovative capacity. It is weakened by too many small and inefficient firms and by the lack of specialization. We indicated in 1972 that while a group of five qualified scientists and engineers was a minimum critical mass for R & D, among 660 Canadian firms reporting scientific activities in 1969, 375 were below that minimum. Thus a great number of companies did not have the capacity to innovate and probably could not afford to develop it. We doubt that the situation has much improved since.

Some people are proposing that Canada should seek the goal of technological sovereignty.* Such an objective is clearly unrealistic. Others contend that our country is almost bound to be a technological colony because of our branch-plant economy. This attitude is too fatalistic and implies that Canadian manufacturing industries are condemned to remain weak.

We believe that it is still possible for Canada to seek greater technological independence through an improved R & D performance. However, most sectors of the Canadian manufacturing industry will not be able to meet this challenge alone. They will need, at least during a transition period that may be long, much more government support and assistance than in most other industrialized countries where manufacturing activities have been designed at the outset to meet international competition.

The committee in 1972 pointed out that filling the technological gap had become one of Canada's most important and urgent national goals. We did not suggest that such a major operation would be easy. On the contrary, we concluded that it would require a radical change in traditions and attitudes, a major industrial conversion with temporary but significant adverse side-effects and deep re-adjustments in the orientation and role of many private and public institutions.

We proposed an overall plan and strategy to achieve this important national objective. The first essential step, we suggested, was to undertake a major conversion of the manufacturing sector aimed at building innovative capacity through horizontal integration and greater specialization.

In our plan, the Department of Industry, Trade and Commerce was to take the leadership in launching this operation, not by finding bureaucratic solutions but by setting up task forces composed of representatives of the industries concerned to consider the specific problems of each manufacturing sector. These groups, operating with an impartial chairman and a small secretariat, were to be asked to prepare reorganization plans intended to improve the innovative capacity, efficiency, and international competitiveness of each sector. We believed this would be a practical and realistic approach because it would involve those who know best in the reshaping of their own industry.

Our proposals met some resistance but also received broad support. Following the publication of Volume 2, the government appeared ready to take the leadership and the then Minister of Industry, Trade and Commerce, the Honourable Jean-Luc Pépin, stated in the House of Commons that he would announce an industrial strategy later in 1972. The announcement was never made, however.

* Dr. Josef Kates, Chairman of the Science Council, uses this expression in his annual statement entitled "Technological Sovereignty, A Strategy for Canada", published in June 1977. However, his concept of sovereignty is restricted to a few areas of particular relevance to Canada and the Committee agrees with the substance of his thesis.

In a brief to the committee in March 1976, ITC indicated that early in 1975 it had proposed a new industrial development policy to Cabinet. The proposals stressed the need to improve the technological performance and capability of Canadian industry, using a sectoral approach. In its brief the department added that it had only recently become possible to start identifying and implementing strategies based on potential strengths.

In May 1976, The Honourable D. C. Jamieson, then Minister of Industry, Trade and Commerce, told the committee that about 20 key industrial sectors had been identified for special analysis, and that in virtually all cases study groups including representatives from the industry or sector concerned were at work, though none of the studies had been completed.

Several years thus elapsed before the government started to deal with the technological gap we had identified as early as 1970 or to adopt the sectoral approach with specialized industrial task forces. No action has yet been taken on this front because the government and industry are still awaiting the reports of the study groups.

The committee suggests that the government should continue to put the emphasis on industrial representation in the task forces and on sectoral strategies. It has relied for too long on overall policies designed to serve national objectives as perceived by an isolated bureaucracy. The time has come to develop more selective policies to serve specific sectoral goals identified by people involved in the real world. It is essential for the government to get creative participation from the private sector rather than reactive consultation. Moreover, the Department of Industry, Trade and Commerce should now set up the Office of Industrial Reorganization that we recommended in 1972 so as to be ready to take quick action when the reports of the study groups are completed.

Our sectoral approach based on active industry participation was strongly supported by Mr. David Mundy, the president of the Air Industries Association. He stated:

> We need to re-think our whole industrial strategy in terms of the development of new mechanisms for the government/industry interface. We think this should be done on an evolutionary basis, and we should start, sector by sector, no matter how small, on a combined government/industry strategy where the partners are on an equal basis and where, by dealing with real life cases, we can improve the machinery in both the public and private sector. Other countries have done it . . . Industry and government on a sector by sector basis must get together to focus and direct the combined leverage of Canadian government and industry to pull this country up by its boot straps through the innovative process.[1]

We believe that if this sectoral approach is applied efficiently, it will do much to remove some major hindrances to industrial innovation. It may even help to change the wrong attitudes toward R & D activities that still prevail in the private sector, and perhaps also provide a concrete basis for improving the technological climate created by government policies.

On the basis of representations from industry, the Committee claimed in 1972, that governments could unconsciously and indirectly create a public ennvironment unfavourable to private innovation. To minimize this danger, we recommended that the Interdepartmental Committee on Innovation be chaired by MOSST and enlarged to discuss the implications of their decisions and policies on the innovative process with the departments and agencies concerned.

These proposals were accepted. However, the Department of Industry, Trade and Commerce told us that the interdepartmental committee had not been active and that in 1975 its functions and responsibilities were assumed by the Interdepartmental Committee on Industrial Policies and Strategies, chaired by ITC, and by the Interdepartmental Committee on Industrial Technology Policy, chaired by MOSST. We fail to see the need for two committees to replace one that has not been active. Moreover, important policy decisions with obvious implications for technological innovations and industrial R & D, like the launching of the anti-inflation program and the abandonment of the Industrial Research and Development Incentives Program, were taken without previous review by those committees. It is not surprising that the public environment surrounding the private innovative process has not been improved in recent years.

If the government does not want to undo unconsciously what it is trying to do directly by other means, there is a great need for a central review mechanism to minimize the unfavourable impact that policies may have on industrial R & D and innovations. We believe, however, that one interdepartmental committee could do a better job than two.

To date the government has failed to deal effectively with the structural weaknesses of Canadian manufacturing industries or to maintain a public environment favourable to innovation. This is the main reason for the inadequate industrial R & D effort and the widening technological gap. If vigorous action is not taken in these two areas, other more direct government measures designed to promote industrial innovation, such as the make-or-buy policy and R & D grants, will only have a marginal effect. This is why the committee attaches such great importance to the task forces or study groups established recently.

DIRECT GOVERNMENT ASSISTANCE TO INNOVATION

While direct public assistance programs cannot go to the root of the problem of the technological gap, they can play a useful role if they are properly designed, if the will and the capacity to innovate exist in the private sector, and if the government provides a favourable climate. The committee made comprehensive recommendations in this area in 1972. Some of them have already been reviewed in this volume.

As mentioned earlier, we proposed the consolidation of intramural R & D programs aimed at manufacturing industries in the Canadian Industrial Laboratories Corporation. To serve industrial needs more efficiently, we recommended, however, that worthwhile intramural programs should be contracted out to industry whenever possible.

During our second inquiry, we have received strong representations from provincial research councils about the make-or-buy policy and the program of unsolicited proposals. While they agreed that industry should receive first priority in the awarding of contracts, they claimed that they were not receiving a fair share of the industrial R & D being contracted out. W. R. Stadelman, president of the Ontario Research Foundation, stated the views of the Association of the Provincial Research Organizations for Technology and Development: "We have, therefore, asked not to be put on a par with the manufacturing industries, who can exploit directly, but on a par with the service sector, and to compete with them for the work."[2] In view of the close relations between industry and these councils, the committee feels this request is justified and should be accepted by the Department of Supply and Services.

The make-or-buy policy has inherent limitations as a tool to promote technological innovations in industry. In theory at least, the scientific activities being contracted out reflect government needs, which may not coincide with the R & D requirements of individual firms. The spin-off effects are not always as great as claimed. Although in this respect the program of unsolicited proposals is preferable to the make-or-buy policy, it would not be healthy for individual firms to develop their R & D effort only or mainly in response to government needs. Such work should be seen as a way of temporarily sustaining scientific activities that are mainly inspired by business objectives.

An American expert in science policy, Robert Gilpin, has summed up the message that the committee has tried to deliver since 1972:

> Everything we know about technological innovation points to the fact that user or market demand is the primary determinant of successful innovation. What is important is what consumers or producers need or want rather than the availability of technological options. Technological advance may be the necessary condition for technological innovation and on occasion new technology may create its own demand but in general and in the short-run, the sufficient condition for successful innovation is the structure or nature of demand.[3]

One implication for government policy is that industrial R & D is not ideally located in government laboratories because there it is usually too supply-push. Another is that the make-or-buy policy should not be seen as the most effective assistance program because it induces industry to adjust its scientific activities to government needs rather than to its potential market. R & D contracts to industry, although highly desirable, should not be seen as a form of direct financial assistance and as substitutes for grants and tax relief.

Indeed, payments made under the make-or-buy policy result from ordinary commercial transactions; they are a financial compensation for services rendered to the government. Yet, as Table 6 (Chapter 1) shows, the share of total government R & D payments to industry represented by contracts has grown from 33 per cent in 1971-72 to an estimated 62 per cent in 1977-78. During this period, real assistance to industry in terms of grants declined from about $95 million to an estimated $80 million in current dollars. The 5 per cent tax credit that has now been extended to R & D financed by industry will only add an estimated amount of $40 million in 1977.

If it is an important goal of the government to help improve the innovative capacity and performance of Canadian industry, then it should concentrate on assistance programs that leave industry as free as possible to determine its scientific activities according to market demand.

Grants or shared-cost programs conform to that requirement, although if they are badly administered they may represent a windfall for firms that had already decided to undertake the R & D without government assistance. In Volume 2 we deplored the multiplicity of grants programs with their varied terms and conditions, problems of overlapping and demarcation, and ineffective and confusing administration. We recommended a single multi-purpose program flexible enough to meet all reasonable special requirements, to be administered by the Department of Industry, Trade and Commerce.

During our recent inquiry, we were told by MOSST that the Interdepartmental Committee on Industrial Technology Policy had been examining that proposal. ITC indicated in March 1976 that Mr. Gordon R. Sharwood had been asked to prepare a report on this topic and that while it was premature to prejudge the conclusion of his review, one goal was to replace the present multiplicity of programs with a single comprehensive program.*

The Minister of State for Science and Technology, Mr. Faulkner, told us in April 1977 of the government response to it. He said that the Industrial Research Assistance Program, IRAP, administered by NRC, and the Defence Industry Productivity Program, DIPP, would continue but that all the other grants shemes had been integrated into a single program called the Enterprise Development Program to be administered by ITC. There are probably good reasons to maintain IRAP and DIPP as separate programs and we feel that the government has implemented the substance of our recommendation five years later.

Indeed, the Enterprise Development Program (EDP) has replaced the Program for Advancement of Industrial Technology (PAIT), the Industrial Design Assistance Program (IDAP), the Program to Enhance Productivity (PEP), the General Adjustment Assistance Program (GAAP), the Automo-

* Mr. Sherwood's report entitled "Evaluation of Industrial Support Programs, Department of Industry, Trade and Commerce", is dated June 1, 1976 but it was only released to the committee's chairman on August 2, 1977.

tive Adjustment Assistance Program (AAA), the Footwear and Tanning Industry Adjustment Program (FTIAP) and the Pharmaceutical Industry Development Assistance Program (PIDA).

EDP combines the basic features of previous programs and is designed to facilitate co-ordination amongst various forms of government assistance related to the different phases of product development. It is confined mainly to small and medium-sized manufacturing industries. It is administered by the Enterprise Development Board assisted by regional boards with delegated approval limits. In addition to public servants, prominent business men will sit on these boards to provide pragmatic and market-oriented expertise. This new program should ensure more flexibility, greater consistency, a less confusing and a more decentralized administration.

In 1962, deductions from taxable income became the first form of government assistance to industrial R & D. In 1966 they were replaced by grants or cost-shared programs. When the committee first received representations from industry in 1969, there was no strong support for these tax deductions. We found during our recent inquiry that industry's attitudes had changed. Most trade associations that appeared before us favoured tax incentives at least as part of the total government assistance program. The joint presentation made by the Canadian Chamber of Commerce and the Canadian Manufacturers' Association contained a strong plea for an unconditional 35 per cent deduction from taxable income for R & D expenditures in addition to other ordinary deductions.

In January 1977, Mr. Sharwood presented another report entitled *Investment for Innovation* to the Ministry of State for Science and Technology. He recommended a credit against federal tax payable amounting to 25 per cent of R & D expenditures. Firms operating in a loss or low tax liability position would carry the credit forward indefinitely. There would be no base year for the program.

Mr. Faulkner has subsequently told the Committee that the 5 per cent tax credit covering capital expenditures which was scheduled to expire on June 30, 1977 would be renewed for another three years and would also be extended to cover R & D current and capital expenditures. He estimated that this extension would provide an incentive of $35 million to $40 million. This is not a vigorous response to the Sharwood proposal.

The government should reconsider its position on tax incentives. A credit that is not related to a base year is ineffective because it applies mainly to R & D expenditures that would have been made with or without the incentive. A larger deduction that would apply only to increases in expenditures should normally be more conducive to a greater R & D effort by industry. The 1962 program provided deductions from taxable income of 150 per cent of any R & D expenditures in excess of those made in 1961. We recommend a return to that approach.

Since 1972, the Government has come more and more to regard R & D contracts to industry as substitutes for grants and tax incentives. This view is wrong. In a country like Canada where the innovative performance has always been weak, it is perfectly normal for the government to offer direct financial assistance to promote R & D performed by industry. We recommend as an immediate and minimum objective that the real value of the amount available in 1972 for R & D grants and tax incentives be restored to stop an undesirable declining trend.

It is claimed by all observers that R & D are the most risky but the least expensive activities related to the innovation process. That is why government contracts, grants, and tax incentives are seen as the most effective means to promote them. The launching of the innovation is less risky but requires more capital. To meet this specific need, in 1972 the committee recommended the creation of a government lending and investing institution called the Canadian Innovation Bank (CIB). In co-operation with private venture capital companies it would support the launching of technological innovations especially in new or existing small and medium-sized firms, and it would also provide managerial services to these enterprises.

Two years later the government re-constituted the Industrial Development Bank under a new name, the Federal Business Development Bank (FBDB), and with a wider mandate. The new bank has been empowered to extend its regional operations and to provide a full range of financial management and information services to small business. In its brief to the committee, the Department of Industry, Trade and Commerce said that the FBDB might meet the need for venture capital that we had identified in 1972. Other studies undertaken by the government have convinced us that this claim is not justified.

In 1975, Robert Grasley presented a report to the Ministry of State for Science and Technology on "The Availability of Risk Capital for Technological Innovation and Invention in Canada." Mr. Grasley supported our recommendation and strongly advocated the creation of a Venture Investment Corporation. In its brief to the committee, MOSST stated that it was examining Mr. Grasley's recommendations. In 1976 the ministry commissioned another study by Gordon Sharwood as a follow-up to the Grasley report. In the meantime, the governments of Ontario, Quebec, and Alberta have taken initiatives in this area of venture capital. In his budget speech in May 1976 the Minister of Finance invited submissions on the subject, but no action has yet been taken by the Canadian government.

In 1973 the committee proposed that the government should organize a "marriage bureau" to help small and medium-sized Canadian enterprises develop partnerships with companies in other countries. We believed this could improve the innovation potential of Canadian firms and give them easier access to international markets. The Department of Industry, Trade

and Commerce has told us that it has established a new centre to promote such partnerships. The centre gathers information on potential joint venture opportunities from a number of sources, including trade commissioners and ministerial missions, and brings these opportunities to the attention of potential Canadian partners.

The committee also made some suggestions to help small inventors. In line with one of our proposals, ITC is now offering financial assistance to the Copyright, Inventions and Patents Association of Canada in support of its efforts to become the national spokesman for the private inventor. The department told us in 1976 that it was considering expanding the role of Canada Patents and Development Limited to include assistance to the private inventor but that no action had been taken yet. On our proposal to institute a series of awards for Canadian innovators and inventors, MOSST simply indicated that Mr. Grasley had supported our suggestion in his report.

THE REORGANIZATION OF THE DEPARTMENT OF INDUSTRY, TRADE AND COMMERCE

In 1972 the committee found that as a result of the 1969 merger, the industry mission of the Department of Industry, Trade and Commerce had been seriously undermined and neglected. We made a comprehensive set of proposals to strengthen it, but we felt that the new responsibilities could not be effectively carried out without a major reorganization at the top.

There seemed to be distinct advantages in having the trade mission and the industrial mission under the same ministerial authority, and it appeared that the trade mission would continue to increase in importance. But we concluded that the technological and industrial mission deserved much greater attention and that it was highly desirable to divide the department along the lines of its two main tasks. In Volume 3 we recommended that a deputy minister of industry be appointed as the senior official responsible for implementing a technological and industrial strategy and for administering its support services and that a senior assistant deputy minister for technology and innovation be designated to work under the new deputy minister.

According to ITC's brief to the committee, the department underwent a major reorganization in 1973 and was still, in March 1976, realigning functions in order to integrate its international trade promotion and industrial development responsibilities more closely. In short, this three-year reorganization was moving in the opposite direction to the one we had suggested and the industrial mission was being further undermined and absorbed by the trade mission.

We had felt that to succeed in its trade mission abroad, the government first needed a coherent technological and industrial strategy at home in order

to induce industry to develop new competitive products. When the then Minister of Industry, Trade and Commerce, Mr. Jamieson, was before the Committee in May 1976, he was asked how he felt about our reorganization proposals for his department. He told us that he had read them, that he had requested a briefing about them, but had not yet reached final conclusions on them.

This delay suggests that the internal instability of ITC in recent years has been aggravated by another factor. Since the committee began to formulate its recommendations in 1972, the department has had four ministers, three deputy ministers, and a rapid turnover in the other top echelons of its administration. We find here the same chronic instability that has so seriously affected MOSST during the same period.

A government department or ministry operating under such conditions cannot be expected to function properly, to take major new initiatives and implement them consistently. This instability is undoubtedly a major factor behind the government delays, timidity, and inaction that have characterized its science policy in recent years.

CONCLUSION

Successive generations of Canadians have deplored the weaknesses of manufacturing industries but they have done very little to correct the situation which is now reaching crisis proportions. The government must show leadership and the Prime Minister should announce that strengthening the manufacturing sector has become a major policy objective. The goal should be to close the Canadian technological gap by bringing the innovative capacity and performance of industry to a competitive level. A desirable target would be to double the real R & D effort performed by industry during the next five years. A clear mandate should be assigned to the Department of Industry, Trade and Commerce with the means to accomplish it effectively.

Our main recommendations to the government in the area of industrial R & D and innovation are as follows:

The Interdepartmental Committee on Industrial Policies and Strategies chaired by ITC should be asked as a matter of high priority to report regularly to Cabinet on the negative implications of decisions and policies of departments and agencies on the innovative process and the industrial R & D effort.

Great importance must be attached to the industrial task forces or study groups being asked to develop sectoral strategies for manufacturing industries including reorganization plans to improve R & D and innovative capacity and ITC should set up an office of Industrial Reorganization to co-ordinate and support the work of these groups and to implement their proposals.

The new and broader make-or-buy policy must be applied quickly and ITC should be given a meaningful role in its implementation. In the awarding of R & D contracts, provincial research organizations should be given the same priority as other agents of the service sector.

The intramural scientific activities remaining within the government and designed to serve manufacturing industries should be consolidated into a single complex of laboratories with strong industrial representation on its board and committees and responsible to ITC.

R & D contracts to industry should not be seen as substitutes for grants and tax incentives and, in consequence, the real value of direct financial assistance offered by the government in 1972 should be restored quickly both in the form of grants and appropriate tax deductions for increased R & D expenditures over a base period.

The role of Canada Patents and Development Limited should be expanded to include assistance to the private inventor and a series of awards for Canadian innovators and inventors should be instituted.

A Canadian Innovation Bank should be created by ITC as a lending and investing institution to support the launching of technological innovations especially in new or existing small and medium-sized firms.

To accomplish all these important tasks effectively, the industrial mission and the commercial mission of ITC should be separated, a deputy minister of industry should be appointed and the department should be given much greater internal stability at the ministerial and top management level than it has had in recent years.

The committee is convinced that if all those proposals were to be implemented quickly and vigorously, the innovative performance of Canadian manufacturing industries would improve substantially.

NOTES AND REFERENCES

1. *Proceedings of the Special Committee of the Senate on Science Policy,* First Session-Thirtieth Parliament, 1974-76, issue no. 26 dated September 9, 1976, p. 26:8.
2. *Proceedings,* Second Session-Thirtieth Parliament, 1976-77, issue no. 6 dated March 6, 1977, p. 6:21.
3. *Technology, Economic Growth, and International Competitiveness,* A report to the Joint Economic Committee, Congress of the United States, July 5, 1975, pp. 65-66.

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SUMMARY AND CONCLUSIONS

THE WASTED YEARS

It is tempting to describe the period between early 1972, when the committee began to present its comprehensive recommendations, and late 1975, when it initiated its second inquiry, as the wasted years for science policy. It is true that soon after the publication of Volume I in 1970 the government decided to create the Ministry of State for Science and Technology. But MOSST, during its first years of existence, had only a marginal impact on science policy: it suffered from internal instability and its low-profile mission was to advise and assist departments and agencies that were jealous of their autonomy.

It is also true that during those years major science programs were formulated in space, oceanography, and energy. The make-or-buy policy was proclaimed in 1972. However, the major programs appeared to be attempts to co-ordinate and consolidate existing but dispersed activities rather than new developments. The make-or-buy policy was limited to new R & D programs in the physical sciences and its positive impact on the scientific activities performed by industry was largely balanced by a reduction in fiscal incentives. At the same time, government efforts to limit the growth of non-statutory expenditures hit the science budget. As a result, science expenditures have been a continually declining fraction of total government outlays since 1970-71.

The committee was not surprised, therefore, to discover at the beginning of its new inquiry that since 1970 the total Canadian science effort measured in real terms had only slightly increased, the share of GNP devoted to national science expenditures had declined, and the gap between Canada and most other advanced countries was widening. The basic deficiencies in the distribution of the national effort observed in 1970 were still present: the government sector was overexpanded and the industrial sector was underdeveloped.

In formulating its recommendations in 1972 and 1973, the committee was inspired by the government's statement in MOSST's 1971 terms of reference: "science and technology vitally affect the well-being of Canadians and the future of Canadian society as a whole". We were therefore disturbed by the stagnation and imbalance of the Canadian science effort as we found it early in 1976, and by the failure of the government to initiate an overall plan, as we had suggested, to correct the situation.

The Senate authorized the committee to launch this more limited inquiry in July 1975. When we began to receive briefs from government departments and agencies and to hear their representatives, we discovered that things were beginning to move and that decisions were being taken in line with the recommendations we had made a few years ago. We suspect that some of these decisions may have been prompted by the launching of our new inquiry. A summary of the highlights of these developments will illustrate this recent take-off.

We have recommended that the government should follow a new procedure in preparing the science budget, give MOSST a meaningful role in the review and assessment of departmental estimates of scientific expenditures, and publish the science budget separately when the Main Estimates were tabled in the House of Commons. We saw the preparation and publication of this science budget as an indispensable tool for formulating and appraising science policy.

The substance of these recommendations has now been accepted although their implementation needs to be improved. Since 1975-76, departments and agencies have had to prepare and submit their science expenditure proposals separately. MOSST has the responsibility for reviewing and assessing these proposals before they are approved by the Treasury Board. The ministry has also published the first issue of *Federal Science Programs* containing the science budget, covering fiscal year 1977-78.

The committee had recommended in 1972 that the government should assign the granting function of the National Research Council to a new foundation for the physical sciences and divide the Canada Council to permit the creation of a special granting body for the social sciences and the humanities. Parliament approved the legislation implementing this recommendation in June 1977. This improved division of labour, together with other suggestions we made which have been accepted, should improve the strategies of public support to research in universities.

In 1972 the committee had expressed its concern about the isolation of the science effort in universities, industry, and government and the immobility of Canadian researchers. We specifically recommended that MOSST, in co-operation with the Public Service Commission and the Treasury Board, should develop a program to improve the mobility of R & D personnel within the government and between universities, industry, and public agencies. The Minister of State for Science and Technology announced in April 1977 that the ministry was considering how to develop such a program. We also welcome Dr. Claude Fortier's statement in May 1976 that the Science Council was setting up a special committee to propose solutions to similar difficulties affecting universities. The immobility of researchers has created a serious problem of aging.

The committee had recommended in 1972 that the government should review all intramural scientific programs to determine their merit and, if worthwhile, whether they could not be contracted out to industry and universities. We felt this was a practical approach to check the over-expansion of the government sector and to assist universities and industry. It was only in April 1977 that the government decided that the make-or-buy principle should be extended to all intramural scientific activities and that the detailed in-house review we had proposed as necessary for the implementation of this overall policy would be undertaken. We contend, however, that contracts awarded under this policy or the unsolicited proposals program should not be regarded as special assistance to universities or industry because they involve payments for services rendered to the government.

In 1972 we had noted that many sectors of Canadian manufacturing industry had a poor capacity for R & D and innovation. Without a major conversion of these sectors, including greater specialization and mergers, measures such as make-or-buy and fiscal incentives would not improve the science effort performed by industry and the flow of innovations. We felt that for this vast, complex conversion to succeed, the industries concerned would have to be actively involved. But the Department of Industry, Trade and Commerce would have to take the initiative and create industrial task forces for the purpose of preparing conversion plans. In May 1976 the then Minister of Industry, Trade and Commerce told the committee that about 20 industrial study groups, each representing a sector of manufacturing, had recently been created.

The committee had found a great variety of government grants programs designed to encourage R & D activities and innovation in industry. We recommended that these programs should be integrated into a multi-purpose program adapted to the different stages of the innovation process. The Department of Industry, Trade and Commerce brief of March 1976 recognized that each of these grants programs "with its own narrow objective, criteria and procedures" had to be replaced by a comprehensive approach. It was only in March 1977, however, that the new Enterprise Development Program was announced as a replacement for the "alphabet soup" approach we had deplored five years earlier.

These are just some of the results of the committee's recommendations. Most were not implemented until 1977. If this kind of action had been taken when we called for it in 1973, the Canadian science effort would have improved substantially by now and we would not be deploring today the same deficiencies that we had detected in 1970.

But delayed action is better than no action. We believe that with the important decisions taken recently, the government has reached the take-off stage in the formulation and implementation of a coherent science policy for Canada. We hope these decisions and actions will now be pursued consistently and vigorously.

The committee attaches special importance to the industrial study groups working on plans to convert the manufacturing industries and improve their technological performance. We assume the Department of Industry, Trade and Commerce gives this operation the same high priority. Unless this operation is efficiently carried out, the government will again fail in what Mr. Drury identified in 1967 as its first obligation—"to ensure that technical innovation activity in our industry is brought to a competitive levels in the shortest possible time."

THE UNFINISHED BUSINESS

Although the take-off stage has been reached, the job to be done even in the immediate future is far from being finished. There are still areas covered by the committee that require active consideration and decisions by the government.

The Ministry of State for Science and Technology is one of those important areas. The ministry has been inserted in the decision-making process in the preparation of the science budget. We feel, however, that it receives many of the departmental proposals too late to be able to assess them carefully and put them together and appraise the total picture. The government should request all departments and agencies to submit their annual science expenditure proposals directly to MOSST at the earliest possible stage of the budgetary process.

However, what the ministry needs most at the moment is internal stability and additional strength to exercise its increasing tasks efficiently. In addition to its current duties, it will have to devote more time to examining budgetary proposals and preparing its annual publication on the science budget. It will be deeply involved in two important studies, one on the mobility of scientific personnel in the Public Service, another on current intramural scientific programs. It will have to provide leadership to the Inter-Council Co-ordinating Committee and the Canadian Committee on Financing University Research. It should vigorously pursue what remains to be done in the reorganization of government scientific institutions. It will have to monitor the opportunities for science and technology to serve national goals as they arise and make sure they are taken up by the appropriate government agencies or by new inter-departmental groups. MOSST will not be able to accomplish all these tasks efficiently if its top management changes too rapidly and its staff is not reinforced.

Science Policy planning: A most important mission that lies ahead for MOSST is to prepare a proper planning framework. In its presentation to the committee in December 1975 the ministry accepted the views we had expressed in 1972 on the special need for planning in the area of science and

technology. Scientific programs usually require several years to be completed and R & D expenditures constitute a long-term investment.

During our recent inquiry, it became obvious that MOSST had not done much concrete work to prepare a plan. It was even reluctant to use targets for the national science effort and its distribution by sectors of performance and specific objectives. Yet a coherent science policy seems inconceivable without a plan and targets indicating at least in general terms the directions the Canadian science effort should follow. We regard targets as the quantitative expressions of objectives: they do not necessarily have to be reached but they are useful guides for action and concrete criteria of performance.

In 1972 we had proposed targets for 1980, using international comparisons and relating science expenditures to GNP. Although this approach has obvious limitations, it has become a common practice in other countries. The target of 2.5 per cent of GNP for 1980 that we had recommended may have been too high. It is now certainly much beyond our capacity. A 1982 target of 1.5 per cent might be more realistic even though it would probably still leave Canada at the bottom of the list of industrialized countries. Whatever the figures and the approach used, we stronly urge MOSST to develop targets for the size and distribution of the national science effort to be attained by 1982 and to submit them to Cabinet for approval. The deficiencies of that effort will not be corrected by accident, as past experience shows.

Once the government has accepted objectives and targets for the national science effort MOSST will be in a position to prepare a science policy framework and a science budget model that can be used to evaluate departmental and agency budgetary proposals, as M^me^ Sauvé promised in February 1974. As long as there is no science budget model detailing the objectives of science policy and the contribution the government is prepared to make to the national science effort, MOSST lacks an adequate reference framework that it can use to review and assess departmental proposals. If the ministry is to play its role intelligently this gap must be filled quickly.

When MOSST presents its science budget framework for approval, we hope that it will be able to convince the government that federal science expenditures should not be submitted to short-term budgetary considerations, that they should increase more regularly and more rapidly than in recent years to conform with national R & D targets, and that priority should be given first to assistance to industry and secondly to the support of R & D in universities. These priorities have not been recognized recently. Here again targets should be used as guides for action and tests of performance.

The Public climate for private innovation: It is obvious that all kinds of government decisions have been taken in recent years without any adequate consideration of their unfavourable impact on the R & D and innovative performance of industry. The way the anti-inflation and austerity programs have been implemented and the mergers legislation has been prepared are

just two examples of this lack of consideration. It is useless for the government to encourage R & D activities in industry through tax credits and other fiscal incentives if other policies tend to discourage it.

In 1972 we proposed that an interdepartmental committee should act as an innovation ombudsman and warn the government about potential or actual threats that new or existing policies might represent for the environment surrounding innovations. The committee was created but never became active. It was replaced by two other bodies dealing with industrial policies and strategies and with industrial technology policy, which do not seem to meet the need that we had detected. MOSST and ITC should reconsider this important question and develop a solution that will really work along the lines we suggested in Volume 2.

Public support to the private sector. Both the university and the industry sectors will benefit from the general application of the make-or-buy policy. However, government R & D contracts should be considered not as direct assistance but as payments for services. The budgetary increase of 12 per cent provided in the estimates of 1977-78 for the granting councils should be regarded as a minimum annual target for the next five years.

The real value that direct government assistance to industrial R & D had in 1972 should be restored in the shortest possible time. In reaching this target, the government should put the emphasis on a tax incentive program similar to that implemented in 1962. A new government program should be developed to provide loans and equity capital to encourage innovations especially by new and existing small and medium-sized firms.

Government reorganization. The detailed review recently undertaken by the government to determine whether current intramural scientific activities are justified and whether they should be contracted out will result in the gradual decline of such activities. To maintain viability and flexibility, a consolidation of remaining programs will become necessary. NRC should be transformed into a national academy where intramural basic research and long-term applied research would be concentrated. A new institution to be called the Canadian Industrial Laboratories Limited should be created to be responsible for remaining intramural R & D programs designed to serve the needs of manufacturing industries.

The industrial task forces or study groups set up by the Department of Industry, Trade and Commerce to prepare plans for the improvement of technological performance in manufacturing industries will be of crucial importance in the development of Canadian innovative capacity. This sectoral approach should be co-ordinated and more systematic. To fill this need, an Office of Industrial Reorganization should be created in ITC. A Canadian Innovation Bank should be established to provide venture capital for innovation by small and medium-sized firms.

Several of our proposals would further develop and strengthen the industrial mission of ITC. It would then become highly desirable to separate that mission from the trade role of the department and to appoint a deputy minister of industry. This reorganization would be necessary to provide the leadership required by a much broader mission and co-ordination between its agencies.

The list of proposals mentioned above constitute the main elements of what the committee considers in 1977 to be the unfinished business. We are convinced that if the government were to act quickly to complete that business, Canada would at last have the tools, the mechanisms and the institutions necessary to implement a coherent and dynamic science policy.

THE FUTURE INVOLVEMENT OF PARLIAMENTARIANS

With the publication of this volume, the Committee considers that it has accomplished its mandate. We are satisfied that our work in recent years has had a considerable impact not only in governments circles but also within the scientific and engineering community and among industrial leaders. We have received many statements to that effect from individuals and associations.

The involvement of parliamentarians with science policy is perceived as important by many Canadians. We find the same perception in most other industrialized countries where parliaments have set up select or standing committees to consider science policy issues on a continuing basis. This is not surprising because science, technology and innovation are affecting in many ways the daily life of citizens and the long-term future of nations. Unless the societies of tomorrow want to suffer from a widening technological gap or to be dominated by technology, they will have to devote much more serious attention to their overall science effort than they have done in the past. This vigilance is a responsibility that belongs to all individuals and groups. But parliamentarians have an obvious and continuing obligation in this respect.

In 1973, we suggested that the House of Commons should become more directly involved with science policy issues. It is still today one of the few elective bodies in the Western World that does not have a standing committee to consider those vital problems. We hope that it will soon establish such a committee.

Even during our first inquiry, many witnesses said they hoped the interest of the Senate in Canadian science policy would continue when our special committee ceases to exist. Already in 1970, we found that this suggestion was sound and we recommended that the Senate appoint a standing committee on science policy to make a general review of major policy issues every five years and to undertake special investigations each intervening year on specific areas and problems of particular interest within the scope of science

policy. We mentioned several specific areas such as scientific and engineering manpower requirements, atomic energy, food technology, communications, scientific and technological information. Since then, the complex problem of technology assessment in the perspective of the physical and human environment has become another urgent issue.

Later, in Volume 3, we came back to this suggestion in the particular context of our proposals regarding the preparation, examination and approval of the science budget. We recommended that an appropriate standing committee of the Senate be authorized to review the annual overall science budget proposed by the government, to hold hearings for this purpose, and to prepare a report containing its comments, suggestions and recommendations.

We suggest that those proposals be implemented during the next session of Parliament. The Senate has received a great deal of credit for providing a public forum on issues raised by science and technology and for contributing to the development of a more coherent Canadian science policy. This task must now be organized on a continuing basis.

If the House of Commons eventually decides to become more systematically involved with science policy issues and proposes a joint committee rather than two separate committees for this purpose, such a proposal should obviously be seriously considered by the Senate. We believe, however, that the House will not reach a decision in the near future and that meanwhile the Senate should continue to fill the gap by having its own standing committee.

APPENDIX A

THE ORGANIZATION OF FUTURES STUDIES

In the committee's mandate, the reference to future studies is not directly related to the main themes developed in this volume. This is why we have decided to cover it separately in an appendix.

In the course of our first inquiry, we found that a new body of knowledge, usually called futures research or futures studies, was rapidly developing abroad. It could be defined as a systematic reflexion, using various methodologies, on indicative or normative medium-term and long-term futures for the purpose of identifying threats and opportunities and providing a broader and less short-sighted basis for decision-making. Although this new body of knowledge was still in its early adolescence, we became convinced of its strategic importance. We also found little significant effort in this field in our country.

In Volume 2 published in 1972, the committee concluded that as a start to correcting the situation, a broadly based lookout institution should be set up to "survey the whole panorama of human activity as it may develop in the medium and long-term future in Canada, with an eye on the world framework".[1] We also recommended that this new program should be undertaken by the Economic Council through the establishment of a committee on the future.

Subsequently, in an unpublished document entitled "Managing the Future", we further developed our ideas and considered the feasibility of establishing what we called a Canadian Centre for Futures Studies as the core of a national network of research activities in this area. We suggested that the proposed centre should be located for a trial period within the Economic Council.

The council responded to the committee's suggestions and created a futures studies group in 1974. This group was active until 1976 when it failed to get further internal support partly because the council had not received any direct encouragement from the government to develop a special program in this area. Indeed, in April 1975, the government decided rather to ask the Institute for Research on Public Policy to undertake that program. But several months later nothing concrete had yet been decided. (Additional information can be found in the committee's report to the Senate presented on July 10, 1975).

In the meantime, a report prepared by the Department of Supply and Services in 1974 claimed that more than 80 Canadian individuals and organizations had indicated an interest and capability in the field of futures research. While that report revealed that Canada had recently developed some strength in this area, it also suggested that this effort might become disjointed and unco-ordinated. This would be most regrettable because of our limited manpower and financial resources. Hence the idea of a co-ordinated national network covering both microscopic and macroscopic studies and based on a sound division of labour between the private and public sectors.

There was another reason why the committee was authorized to review the state of futures studies in Canada, mainly within the Canadian government. We had found that there was no inventory of the research programs being carried out even in the public sector. We felt that this information gap had to be filled as a preliminary step to developing a coherent approach to this new research area.

THE INSTITUTE FOR RESEARCH ON PUBLIC POLICY

During our second inquiry, we found that the proposal presented to the Institute by the Privy Council Office embodied the substance of the initial program of futures studies we had recommended in 1972. The Institute asked Dr. George Lindsey to make a feasibility study of that proposal including the establishment of a Centre for Futures Studies. Dr. Lindsey's report was approved by the Institute's board of directors in April 1976 and formed the basis of negotiations with the Privy Council Office that resulted in the completion of a contract in November of the same year.

Dr. A. W. R. Carrothers, the Institute's president, told the committee in February 1977 that the contract covered a three-year period and was supported by a grant of $1.366 million and that the Institute viewed these three years as a "start-up" period during which a base would be established for a continuing program. He further stated:

> "The mandate of the futures studies program is three-fold: (1) to identify which aspects of Canadian society are changing most rapidly; (2) to provide commentaries and

projections on data collected and published by other agencies; and (3) to examine the effects of economic and technological changes on Canadian society. Our intention is that the program publish an annual review of changes in Canadian society, together with occasional papers and special reports as the work of the program may support".[2]

Dr. Carrothers also informed the committee that the Institute had selected Dr. J. David Hoffman as director of the program and that he had started to work on February 1, 1977. Thus, five years elapsed between the formulation of our proposal in 1972 and the beginning of its implementation in 1977. We hope that a high priority will be given by the Institute to that important research program as a preliminary step toward the creation of the Canadian Centre for Futures Studies.

THE INVENTORY OF FUTURES RESEARCH ACTIVITIES

In October 1975, the committee sent a detailed questionnaire on futures research activities to all government departments and agencies. The text of that questionnaire is reproduced as an appendix to issue No. 1 of our proceedings dated December 3, 1975. This proved to be the first systematic survey of futures research programs being carried out within the Canadian government. We also circulated our questionnaire to a number of private firms.

The initiative taken by the committee in this respect had a much greater impact than we expected at first. It produced information which had not been available before even to government officials. The Ministry of State for Science and Technology undertook an analysis of the answers we had received. This document entitled "The Lamontagne Survey of Futures Studies; an Analysis and Summary" is now available to the public. We have reproduced it as issue No. 13 of our proceedings dated June 1977. Dr. A. R. Demirdache, general director of the technology Assessment Division in MOSST, told the committee that the analysis had produced "a much better insight into what was really happening, and it brought to our attention many things we had forgotten or had not seen before. It gave us more information about the private sector."[3] The committee is also pleased to note that MOSST has decided to make periodic inventories from now on, based on improved versions of our questionnaire.

A PUBLIC NETWORK OF FUTURES STUDIES

Our initiative in the area of futures research produced two other tangible results within the Canadian government. First, the Coordinating Committee on Evaluation became the Coordinating Committee on Evaluation and Planning with broader terms of reference. This central agency committee is

at the assistant deputy-minister level and is co-chaired by the Deputy Secretary of Planning Branch, Treasury Board Secreatariat and by the Deputy Secretary of the Cabinet (Plans). It also includes other representatives from Finance, the Privy Council Office, Treasury Board Secretariat Program Branch and the Ministry of State for Science and Technology.

When he appeared before us, in his capacity of co-chairman, Mr. Timothy E. Reid described the new functions of his committee:

> "In more detail, the purposes of this committee are to identify major policy planning and evaluation issues including those with long-term implications likely to be of concern to Cabinet in a year or two; to assess priority evaluation needs with a view to identifying gaps in the planning efforts of departments; and to stimulate comprehensive studies often cutting across departmental mandates in order to help ensure that these evaluation gaps are filled. The committee also acts as liaison on policy matters with certain intergovernmental and private organizations which are pursuing activitis in futures forecasting, systems analysis and long-term policy analysis relevant to the government policy concerns."(4)

We were told that the broader terms of this most important coordinating committee of officials were the direct results of our suggestions. Mr. Reid said: "In Canada, the initiatives taken in 1975 by the Senate Special Committee on Science Policy served to dramatize the importance of long-range planning activities to decision-makers at all levels of our parliamentary system."(5)

More specifically, when Mr. Reid was asked if there had been a relationship between our initiatives and the mandate of the coordinating committee of officials, he said:

> "The answer to that is unequivocal. It is "yes". I do not think it started simply with your letter of a year or so ago. It started with your reports of 1970 and 1973. There has been a buildup of incorporating a long-term perspective into the day-to-day decisions which are made under great pressure by the government . . . The coincidence of your letter with the thinking that there needed to be this informal committee to coordinate major evaluation projects and issues was not just coincidental. There was a causal relationship there.(6)

Our interest in futures studies had another important result: the creation of the Interdepartmental Committee on Futures Research, chaired by the Director General of the Technological Assessment Division in MOSST. This committee provides a central focus for groups in the federal government engaged in futures studies and a forum for interdepartmental discussions and dissemination of information pertaining to those studies.

In addition, a Secretariat for Futures Studies was established for monitoring all futures studies in the federal government, and for serving as a central contact point for general information purposes for persons and organizations outside the government. When Mr. Reid described to us the activities of this secretariat he said:

> ". . . the secretariat is currently assessing the futures research activities in various government departments using the Senate Committee's survey as a starting point. It is

> hoped that this study will reveal some of the problems and opportunities associated with the development of departmental futures studies programs . . . This continuing inventory of futures studies also throws light on gaps and overlaps which, if significant, can be reported to the Coordinating Committee on Evaluation and Planning."[7]

Thus, as a result of our committee's initiative, a coordinated network of futures studies has been developed within the Canadian government. As described by Mr. Reid, two central requirements have been identified for the effective functioning of that network. First, the need to give central leadership and guidance to ensure that departmental futures research and long-term planning efforts contribute effectively to the overall process of policy development and cover the priorities of the government. This requirement is met by the Coordinating Committee on Evaluation and Planning. Second, the need for communication and information exchange among groups in government departments engaged in futures research and for a clearinghouse gathering information on what futures studies are being done, by whom, and the methodologies being used. This second requirement is being met by the Interdepartmental Committee on Futures Research and its secretariat located in MOSST. We were also told that those two committees are keeping regular contacts with individuals and organizations interested in futures studies both in Canada and abroad.

THE CANADIAN ASSOCIATION FOR FUTURES STUDIES

When we became interested in futures studies in 1972, there was no national inventory, no journal and no national association dealing with this new body of knowledge. These gaps are now being filled.

In February 1976, a conference was held at the University of Western Ontario to establish the Canadian Association for Futures Studies. It was organized by Professor Hugh A. Stevenson, assisted by Dr. Saul Silverman and others. About 180 people attended the meeting. The Association held its second national conference in June 1977 at Queen's University in Kingston. The chairman of our committee was invited to act as honorary president. The general theme "Shaping the Future" was discussed under various specific topics by about 600 participants.

Following this conference, Mr. Robert Bradley, the treasurer of the Association wrote to our chairman as follows: "The Association would not have been formed without the ideas arising from your Committee, nor would it have continued to grow in strength in its initial year of operation but for the objectives and ideals which you initiated."

We believe that the Canadian Association of Futures Studies has a most important role to play in providing a meeting place and a public forum for suppliers and users of futures studies. It must also become an impartial observer and critic of the national network of futures studies as it develops in

Canada. The Association deserves all the support it needs to carry out its important missions.

CONCLUSION

In spite of delays and initial hesitations, Canada has made significant progress toward building a co-ordinated network of futures research as envisaged by the committee since 1972. This network now has the basic institutions and links it needs to operate properly. However, we must make sure on a continuing basis that those organizations and mechanisms will always serve their purpose and contribute to intensify futures research of high quality and relevance to Canadian needs.

Canadians are now facing the collective challenge of "inventing the future", as Denis Gabor put it. This is not going to be an easy task. It will require a high degree of moral qualities and a firm will to change and revitalize our lifestyles and our institutions. It will also require a new enlightenment, a more systematic reflextion on the future. Indeed, without a better and more widely shared view of alternative futures, it will be impossible for us to generate the collective will necessary to build a new society more respectful of the environment and more attentive to the unprecedented predicament of mankind. This is why futures studies have become so important and so urgent.

NOTES AND REFERENCES

1. Report of the Senate Special Committee on Science Policy, Vol. 2, *Targets and Strategies for the Seventies*, Ottawa, 1972, pp. 406-409.
2. *Proceedings of the Special Committee of the Senate on Science Policy*, Second Session-Thirtieth Parliament, 1976-1977, Issue No. 4 dated February 23, 1976, p. 4:6
3. *Proceedings*, Issue No. 5 dated March 9, 1977, p. 5:18.
4. *Proceedings*, ibid., p. 5:11-12.
5. *Proceedings*, ibid., p. 5:6.
6. *Proceedings*, ibid., p. 5:17.
7. *Proceedings*, ibid., p. 5:11.

APPENDIX B

GOVERNMENT AGENCIES AND OTHER GROUPS THAT PRESENTED BRIEFS AND APPEARED BEFORE THE COMMITTEE

(First Session of the thirtieth Parliament 1974-76)

Issue No.	Date	Witnesses
1	December 3, 1975	From the *Ministry of State for Science and Technology:* The Honourable C. M. Drury, Minister Dr. M. J. LeClair, Secretary
2	December 16, 1975	From the *Ministry of State for Science and Technology:* The Honourable C. M. Drury, Minister Dr. M. J. LeClair, Secretary Mr. D. H. E. Cross, General Director, Program Review and Assessment Division, Government Branch
3	February 11, 1976	From the *Ministry of State for Science and Technology:* Dr. M. J. LeClair, Secretary Mrs. L. M. Thur, Senior Assistant Secretary, University Branch Mr. Jim Mullin, General Director, International Division
4	February 18, 1976	From the *Ministry of State for Science and Technology:* The Honourable C. M. Drury, Minister Dr. M. J. LeClair, Secretary Dr. Peter Meyboom, Assistant Secretary, Industry Branch Dr. A. R. Demirdache, Director, Technological Forecasting and Technology Assessment Division
5	March 10, 1976	From the *Ministry of State for Science and Technology:* The Honourable C. M. Drury, Minister Dr. M. J. LeClair, Secretary

Issue No.	Date	Witnesses
6	March 17, 1976	From the *Department of Industry, Trade and Commerce:* Mr. Lubor F. Drahotsky, Assistant Deputy Minister, Industrial Policies Dr. Sydney Wagner, General Director, Office of Science and Technology
7	March 24, 1976	From the *Department of Industry, Trade and Commerce:* Mr. Lubor F. Drahotsky, Assistant Deputy Minister, Industrial Policies Dr. Sydney Wagner, General Director, Office of Science and Technology Mr. W. R. Graham, Acting Director, Program Office, Finance and Programs
8	March 31, 1976	From the *Science Council of Canada:* Dr. Josef Kates, Chairman Dr. Claude Fortier, Vice-Chairman Mr. John J. Shepherd, Executive Director
9	April 7, 1976	From the *Science Council of Canada:* Dr. Josef Kates, Chairman Mr. John J. Shepherd, Executive Director
10	May 5, 1976	From the *Science Council of Canada:* Dr. Josef Kates, Chairman Dr. Claude Fortier, Vice-Chairman Mr. John J. Shepherd, Executive Director
11	May 12, 1976	From the *Department of Industry, Trade and Commerce:* The Honourable D. C. Jamieson, Minister Dr. Sydney Wagner, General Director, Office of Science and Technology
12	May 19, 1976	From the *National Research Council of Canada:* Dr. W. G. Schneider, President Mr. W. A. Cumming, Vice-President, Laboratories Dr. R. D. Hiscocks, Vice-President, Industry Dr. Pierre Grenier, Member Dr. Gilles Julien, Director, Office of Grants and Scholarships
13	May 26, 1976	From the *National Research Council of Canada:* Dr. W. G. Schneider, President Mr. W. A. Cumming, Vice-President, Laboratories Dr. R. D. Hiscocks, Vice-President, Industry
14	June 9, 1976	From the *National Research Council of Canada:* Dr. W. G. Schneider, President Mr. W. A. Cumming, Vice-President, Laboratories Dr. R. D. Hiscocks, Vice-President, Industry Dr. B. A. Gingras, Vice-President, University Grants and Scholarships

Issue No.	Date	Witnesses
15	August 10, 1976	From the *Department of Agriculture:* Dr. B. B. Migicovsky,Assistant Deputy Minister Research Dr. D. G. Hamilton, Director General, Planning and Evaluation Directorate
16	August 10, 1976	From the *Department of the Environment:* Dr. E. F. Roots, Science Adviser, Planning and Finance Service Mr. J. P. Bruce, Acting Assistant Deputy Minister, Environmental Management Service Dr. M. C. B. Hotz, Director, Integrated Programs Branch, Planning and Finance Service Mr. W. K. Sharpe, Director, Water Pollution Programs Branch, Water Pollution Control Directorate, Environmental Protection Service Mr. F. G. Hurtubise, Director General, Environmental Conservation Directorate, Environmental Protection Service Dr. A. E. Collin, Assistant Deputy Minister, Ocean and Aquatic Sciences Dr. A. May, Acting Director General, Resource Services Directorate, Fisheries Management Dr. F. J. Bourchier, Director General, Canadian Forestry Service From the *Fisheries Research Board* Dr. J. R. Weir, Chairman
17	August 11, 1976	From *Atomic Energy of Canada Limited:* Dr. J. S. Foster, President Dr. A. M. Aikin, Vice-President, Administration and Planning Dr. A. J. Mooradian, Vice-President, Chalk River Nuclear Laboratories
18	August 11, 1976	From the *Department of Energy, Mines and Resources:* Dr. J. D. Keys, Assistant Deputy Minister, Science and Technology Dr. Ron Niblett, Division of Geomagnetism, Earth Physics Branch
19	August 12, 1976	On behalf of the *Canadian Chamber of Commerce,* the *Canadian Manufacturers' Association* and the *Canadian Research Management Association*

Issue No.	Date	Witnesses
		Mr. George A. Chapman, The Steel Company of Canada, Limited Chairman, CMA R&D Committee; Dr. Owen C. W. Allenby, Du Pont of Canada Ltd. Chairman, Joint Committee Drafting Submission; Dr. George L. Bata, Union Carbide Canada Limited Chairman, Canada Research Management Association R&D Committee; Dr. Gordon H. Segall, Canadian Industries Limited Chairman, Canadian Chemical Producers Association R&D Committee; Dr. Ron S. Stuart, Merck Frosst Laboratories Chairman, Canadian Chamber of Commerce, R&D Committee; Mr. G. C. Hughes, Director, Legislation, Taxation & Technical group, The Canadian Manufacturers' Association. From the *Pharmaceutical Manufacturers' Association of Canada* Mr. W. M. Garton, President, Mr. M. G. Fruin, Vice-Chairman of the Board, Mr. G. Beauchemin, Executive Vice-President and Treasurer, Dr. Ron S. Stuart, Merck Frosst Laboratories, Mr. R. E. Everson, Director of Research.
20	August 12, 1976	From *The Royal Society of Canada:* Dr. J. Larkin Kerwin, President, Rector, Laval University; Dr. W. Bennett Lewis, President, Academy of Science, Professor, Queen's University; Dr. S. Delbert Clark, Professor, University of Guelph; Dr. Donald G. Hurst, Fellow, Executive Director; Dr. Donald J. LeRoy, Fellow, Principal Research Officer, National Research Council of Canada.
21	September 7, 1976	From *The Canadian Council of Professional Engineers:* Mr. C. J. Moull, President Mr. L. M. Nadeau, General Manager Mr. L. C. Sentance, Acting Executive Director, Association of Professional Engineers of Ontario

Issue No.	Date	Witnesses
		From *The Engineering Institute of Canada:* Mr. Robert F. Shaw, President Mr. Byron T. Kerr, General Manager Mr. D. L. Mordell, Immediate Past-President
22	September 7, 1976	From SCITEC—*The Association of the Scientific, Engineering & Technological Community of Canada:* Dr. Peter A. Forsyth, President Dr. H. R. Wynne-Edwards, Vice-President Dr. Michel Bergeron, 2nd Vice-President Mr. J. Y. Hartcourt, Executive Director. *The National Committee of Deans of Engineering and Applied Science:* Mr. G. W. Frennel, Dean, Faculty of Engineering, McGill University. Mr. D. J. Laurie Kennedy, Dean, Faculty of Engineering, University of Windsor. *The Chemical Institute of Canada:* Mr. J. A. Morrison, President Mr. T. H. G. Michael, General Manager. *The Association of Consulting Engineers of Canada:* Mr. P. T. Beauchemin, President Mr. D. Newman, Past Chairman, R & D Committee Mr. Ian McCaig, Incoming Chairman, R & D Committee Mr. H. R. Pinault, Managing Director.
23	September 8, 1976	From the *Medical Research Council:* Dr. G. Malcolm Brown, Chairman. *The Association of Canadian Medical Colleges:* Dr. David Bates, M.D., Chairman, Committee on Research and Graduate Studies, Dean of Medicine, Professor of Medicine and Physiology, University of British Columbia; Dr. Douglas Waugh, M.D., Executive Director; Dr. David Z. Levine, M.D., Associate professor of Medicine and Physiology, University of Ottawa; Dr. Pierre H. Beaudry, M.D., Associate Professor of Paediatrics and Associate Dean for Research and Graduate Studies, Faculty of Medicine, McGill University.

Issue No.	Date	Witnesses
24	September 8, 1976	From *Canadians for Health Research:* Mrs. Patricia Harris, Member of the Coordinating Executive Committee and National President, Canadian Rehabilitation Council. *Biological Council of Canada:* Dr. D. F. Mettrick, Chairman and Professor, Department of Zoology, University of Toronto; Dr. D. B. Walden, Past-President, Professor, Department of Plant Science, University of Western Ontario; Professor K. G. Davey, Chairman, Canadian Committee of University Biology Chairmen, Professor and Chairman of the Department of Biology, York University. *Canadian Biochemical Society:* Dr. J. M. Neelin, Chairman and Professor, Department of Biology, Carleton University; Dr. David MacLennan, Professor at The Banting and Best Department of Medical Research, University of Toronto.
25	September 9, 1976	From *The Canadian Council of Urban & Regional Research* Professor Meyer Brownstone, President; Mr. Serge Boucher, Vice-President; Mr. Vernon Lang, Executive Director; Mr. Hans Blumenfeld; Mr. Robert Cournoyer; Mr. John Hitchcock. *Social Science Research Council of Canada* Dr. J. J. Loubser, Director. *Humanities Research Council of Canada* Dr. David Steedman, Academic Director; Mr. Pierre Savard, Past Chairman. *Canadian Political Science Association* Professor Hugh Thorburn, President-Elect; Professor Conrad Winn, Secretary-Treasurer.

Issue No.	Date	Witnesses
26	September 9, 1976	From the *Electronic Sector of Electrical and Electronic Manufacturers Association of Canada:* Honourable Léon Balcer, Executive Vice-President, Electrical and Electronic Manufacturers' Association of Canada; Mr. H. Lloyd Webster, Director; and Vice-President, Northern Telecom Limited; Mr. Keith Rapsey, Director; Allen-Bradley Limited; Mr. Ken D. Mills, Manager, Engineering, Electronic Systems Division, Westinghouse Canada Limited; Mr. I. A. Mayson, Vice-Chairman, Electronic Systems Division, and Vice-President and General Manager, Government and Commercial Systems Division, RCA Limited; Dr. T. W. R. East, Director of Advanced Development, Raytheon Canada Limited; Dr. F. J. F. Osborne, Director, Communications and Space Technology Laboratory, RCA Limited; From *Air Industries Association of Canada:* Mr. David Mundy, President; Mr. J. D. MacNaughton, Vice-Chairman; and Vice-President SPAR Aerospace Product; Mr. K. F. Gibson, General Manager of Leigh Instruments Ltd.; Mr. Sidney Young, Chief Engineer of Douglas Aircraft of Canada Ltd.

(Second Session of the thirtieth Parliament 1976-77)

1	December 8, 1976	From *Atomic Energy Control Board:* Dr. A. T. Prince, President Mr. Paul E. Hamel, Director of Research and Coordination Mr. J. H. F. Jennekens, Director of Licensing
2	December 15, 1976	From *The Canada Council:* Mrs. Gertrude Laing, Chairman Mr. Michel Bélanger, Vice-Chairman Mr. Mavor Moore, Member Mr. Timothy Porteous, Associate Director Mr. Frank Milligan, Associate Director for University Affairs
3	February 9, 1977	From the *Medical Research Council:* Dr. G. Malcolm Brown, Chairman
4	February 23, 1977	From the *Institute for Research on Public Policy:* Dr. A. W. R. Carrothers, President Dr. David Hoffman, Director, Futures Studies Program From the *Department of National Defence:* Dr. George R. Lindsey, Chief, Operational Research and Analysis

Issue No.	Date	Witnesses
5	March 9, 1977	From the *Coordinating Committee on Evaluation and Planning:* Mr. W. B. Snarr, Assistant Secretary to the Cabinet Planning Projects, Privy Council Office. Mr. Timothy E. Reid, Co-Chairman, and Acting Deputy Secretary, Planning Branch, Treasury Board. Mr. Richard Bower, Secretary, and, Director, Effectiveness Evaluation Division, Planning Branch, Treasury Board. From the *Interdepartmental Committee on Futures Research:* Mr. A. R. Demirdache, Chairman and General Director, Technological Assessment Division, Ministry of State for Science and Technology.
6	March 16, 1977	From *Pro—The Association of the Provincial Research Organizations for Technology and Development:* Dr. E. J. Wiggins, President of PRO and Director, Alberta Research Council; Dr. P. C. Trussell, Director, British Columbia Research; Dr. T. P. Pepper, Director, Saskatchewan Research Council; Mr. W. R. Stadelman, President, Ontario Research Foundation; Mr. Onil Roy, Commercial Director, Quebec Industrial Research Center; Dr. C. Bursill, Executive Director, New Brunswick Research & Productivity Council.
7	April 27, 1977	From the *Ministry of State for Science and Technology:* Mr. Denis Hudon, Secretary Mr. D. B. Dewar, Assistant, Secretary, Government Branch Mr. D. C. Thom, General Director, Industry Projects Division
8	May 25, 1977	From the *Ministry of State for Science and Technology:* Mr. Denis Hudon, Secretary Mr. D. B. Dewar, Assistant Secretary, Government Branch Mr. Dalton H. E. Cross, General Director, Program Review and Assessment Division, Government Branch

APPENDIX "C"

ALL BRIEFS RECEIVED FROM GOVERNMENT AGENCIES AND OTHER GROUPS HAVE BEEN PRINTED IN WHOLE OR IN PART IN THE FOLLOWING PROCEEDINGS OF THE COMMITTEE

(First Session of the Thirtieth Parliament—1974-76)

Issue No.	Name of Organization Originating the Brief
1	Ministry of State for Science and Technology
7	Department of Industry, Trade and Commerce
8	Science Council of Canada
14	National Research Council of Canada
15	Department of Agriculture
16	Department of the Environment
17	Atomic Energy of Canada
18	Department of Energy, Mines and Resources
19	Joint brief by the Canadian Chamber of Commerce, the Canadian Manufacturers' Association and the Canadian Research Management Association; The Pharmaceutical Manufacturers' Association of Canada
20	The Royal Society of Canada
21	Joint brief by the Canadian Council of Professional Engineers and The Engineering Institute of Canada
22	SCITEC (The Association of the Scientific, Engineering and Technological Community of Canada National Committee of Deans of Engineering and Applied Sciences The Chemical Institute of Canada Association of Consulting Engineers of Canada
23	Medical Research Council The Association of Canadian Medical Colleges
24	The Biological Council of Canada The Canadian Biochemical Society
25	The Canadian Council of Urban and Regional Research Social Science Research Council of Canada
26	The Electronic Section of Electrical and Electronic Manufacturers Association of Canada

(Second Session of the Thirtieth Parliament—1976-77)

Issue No.	
1	Atomic Energy Control Board The Canada Council
6	PRO—The Association of the Provincial Research Organizations for Technology and Development
9	Department of National Health and Welfare Addendum to the brief presented by the Department of National Health and Welfare Canadian International Development Agency Department of Transport Department of National Defence
10	Statistics Canada Department of Manpower and Immigration Department of Communications Bell-Northern Research Limited in Association with Bell Canada and Northern Telecom Limited Department of Public Works
11	Department of External Affairs Department of Labour Canadian National Railways Alcan Aluminium Limited The Manitoba Research Council Canadian Teacher's Federation Canadian Patents and Development Limited Central Mortgage and Housing Corporation Loram Group
12	McGill University University of Waterloo University of Saskatchewan Unversity of Alberta University of British Columbia Memorial University of Newfoundland Royal Architectural Institute of Canada MacMillan Bloedel Limited Aviation Electric Limited
13	The Lamontagne Survey of Future Studies: An Analysis and Summary. Report from the Secretariat for Future Studies, Ministry of State for Science and Technology
14	Department of Indian Affairs and Northern Development Canadian Political Science Association

APPENDIX D

SUMMARY OF RECOMMENDATIONS

A Science Policy for Canada: Volume 1—A Critical Review: Past and Present

Chapter 1: The Senate Inquiry: Its need, scope and method

1.	P.17	... That the Senate appoint a standing committee on science policy to make a general review of major policy issues every five years and to undertake special investigations each intervening year on specific areas or problems of particular interest within the scope of science policy.

A Science Policy for Canada: Volume 2—Targets & Strategies for the Seventies

Chapter 13: Broad Framework and Target for Science Policy for the Seventies

1.	P.408	... That the Economic Council should enlarge its activities and establish a special Committee on the Future, with broad terms of reference but looking more specifically at the years 2000 and 1985 and attempting to project various possible environments that could emerge from the extrapolation of identifiable Canadian trends within the international context.
2.	P.409	... That the Senate sponsor a conference for the purpose of establishing a Commission on the Future whose responsibility would be to help as many private and public organizations as possible to forecast and build their future not only in isolation but together.
3.	P.410	... That the Canadian government and Parliament adopt an overall plan for the Seventies for science and technology, based on longer-term projections and overall national R&D targets, and that the procedures and organization of the planning, programming, and budgeting system be improved to provide a better assessment, of the output of R&D activities and a better basis for determining annual appropriations for the financing of such activities. We also recommend that by 1980 the approach be formalized in a framework of successive five-year plans.
4.	P.413	... That the Ministry of State for Science and Technology be made responsible for keeping a national R&D inventory and be made responsible for developing a national audit of current R&D programs and projects being supported by public funds.
5.	P.421	... That the national expenditure on R&D should reach 2.5 per cent of GNP by 1980, it being understood that the Canadian Government's direct contribution to reaching this target will be restricted to the support of worthwile programs and projects.

6.	P.439	1) ... That a Canadian Research Board be set up, together with three foundations, to report to the Secretary of State and to be responsible mainly for the development of a capacity for and the support of curiosity-oriented basic research in universities and similar institutions;
7.		2) ... That the three foundations cover the physical sciences, the life sciences, and the social sciences and humanities and bear the full cost, both direct and indirect, of the projects and programs they select to support in this area: and
8.		3) ... That the responsibility for preparing university teachers and for supporting their research on the existing stock of knowledge designed to improve their teaching be left to provincial governments and universities within the framework of existing federal-provincial arrangements for the financing of post-secondary education.
9.	P.443	... That approximately 10 per cent of the national R&D effort be devoted to basic research by 1980 and that an immediate start be made toward this target.
10.	P.453	1) ... That the proposed foundations, in their efforts to develop and support excellence in curiosity-oriented research, follow a strategy emphasising quality rather than quantity;
11.		2) ... That they continue or establish programs of post-doctoral fellowships awarded for a maximum period of five years;
12.		3) ... That they provide research grants only to applicants who have demonstrated international quality standards in their past performance but that excellence be more generously rewarded and subjected to less administrative control; and
13.		4) ... That they improve their peer system, wherever necessary, to ensure the highest possible degree of competence and impartiality.
14.	P.455	... That the Minister of State for Science and Technology initiate a thorough re-appraisal of all the Canadian government's scholarship and fellowship schemes in the light of the current scientific and technological manpower situation and of the likely requirements of the new orientation that the national R&D effort will take in the 1970s. This study should be conducted in close collaboration with the proposed foundations and the Department of Manpower and Immigration.
15.	P.456	... That the proposed foundations, in applying the criterion of social merit, turn down research projects or programs that involve undesirable duplication of others carried out elsewhere in the country or abroad and assist only those that are relevant to the Canadian scene. We further recommend that the foundations reject Big Science projects to be carried out with Canadian support alone.
16.	P.461	... That at least during the 1970s the order of priority in government support for curiosity-oriented basic research should be, first, the social sciences and the humanities, and second, the life sciences, mainly those related to human health, provided of course that international standards of excellence can be developed and achieved in these areas.

17.	P.467	1) ... That the Minister of State for Science and Technology undertake a detailed review of the basic research activities carried out by all government agencies to see if they are justified and, if so, to consider whether some of them could not be advantageously transferred to universities;
18.		2) ... That in the future most basic research activities of the Canadian government be concentrated in a national research academy, with three institutes for the physical sciences, the life sciences, and the social sciences, with the purpose of filling gaps in basic research, especially in the social sciences and the life sciences; and
19.		3) ... That a substantial portion of the work of the institutes be performed at the request of government agencies and private firms on a fee basis.

Chapter 15: Industrial Innovation: Targets and the Private Environment

20.	P.499	... That the R&D activities performed by the industrial sector be substantially increased so that by 1980 they represent a maximum of about 60 per cent of the national R&D effort.
21.	P.508	1) ... That secondary manufacturing industries be requested by the Minister of Industry, Trade and Commerce to organize task forces, with proper labour representation, to consider the problems of scale and specialization and to prepare a plan within a year to improve the efficiency, the innovative capacity and the international competitiveness of individual firms through mergers or otherwise;
22.		2) ... That the minister appoint an impartial chairman and a small secretariat to assist each task force;
23.		3) ... That a special Cabinet committee be appointed under the chairmanship of the Minister of Industry, Trade and Commerce to examine, modify, and approve, after consultation with the interested provinces, the plans prepared by the industrial task forces; and
24.	P.509	4) ... That an Office of Industrial Reorganization, mainly composed of the chairmen and the secretariat of the task forces, be established to assist the Cabinet committee.
25.	P.512	... That resource-based and primary manufacturing industries be requested by the Minister of Energy, Mines and Resources to organize specific task forces, with proper labour representation, to consider their innovative and R&D performance and within a year to prepare a plan to improve that performance in order to economize resources, utilize wastes more efficiently, reduce costs of production, discover new uses for their products, and further process these products in Canada for export.
26.	P.521	... That the Minister of State for Science and Technology appoint a task force composed of representatives of universities and industry to estimate the number and distribution of QSEs that the industrial sector will require in the 1970s and to determine the qualifications and training they should have, in the light of the government decisions regarding targets and strategies for industrial R&D and innovation during the decade.

27. P.522 ... That the Minister of State for Science and Technology sponsor a national conference widely representative of the academic and industrial sectors to consider their complementary roles in the national science, technology, and innovation effort, to identify ways and means of helping each other to accomplish their missions better, and to devise the best possible permanent institutional basis for maintaining a continuing liaison and co-operation in the future.

28. P.529 1) ... That the Minister of State for Science and Technology set up a special committee with representatives from Canadian university schools of management and the Canadian Research Management Association to develop a training program for R&D managers and a research program on the organization of R&D activities and of innovation strategies;

29. 2) ... That the committee select Canadian centres in different regions to be mainly responsible for the proposed training program and choose the best qualified researchers to carry out the research program; and

30. 3) ... That the Minister of State for Science and Technology establish a program of scholarships to be awarded by this management training committee and provide the full financing of the research program and an annual grant to the Canadian Research Management Association to enable it to extend its activities in conjunction with the proposed programs.

Chapter 16: Industrial Innovation and the Canadian Government's Impact

31. P.562 1) ... That all government departments and agencies which can have a significant but indirect impact on the industrial innovative process while serving their main missions, acquire the services of science policy advisers whose responsibility would include drawing attention to that impact when administrative decisions are taken and new policies are formulated;

32. 2) ... That the scope, composition, and authority of the Interdepartmental Committee on Innovation be enlarged to review, appraise, and discuss with the departments and agencies concerned the implications on the innovative process of their decisions and policies and, if necessary, to prevent recommendations to the Cabinet committee responsible for science policy; and

33. 3) ... That the Minister of State for Science and Technology be responsible for reporting to Cabinet the recommendations accepted by the Cabinet committee on these issues and that his staff provide the chairmanship and the secretariat of the interdepartmental committee.

Chapter 17: Industrial Innovation and Direct Government Assistance

34. P.578 1) ... That all existing specific grants designed to encourage R&D activities in industry be integrated into one multipurpose program, and be administered by the Department of Industry, Trade and Commerce in the light of the broad guidelines proposed for the determination and management of these subsidies; and

35.		2) ... That a lending and investing institution called the Canadian Innovation Bank (CIB) be created to support in co-operation with private venture capital companies the activities involved with the launching of technological innovations, especially in new or existing small and medium-sized firms, to provide managerial services to these enterprises and to be responsible to the Department of Industry, Trade and Commerce.
36.	P.589	1) ... That a detailed and continuing review be undertaken by the Ministry for Science and Technology of current and future industrial R&D programs of government departments and agencies involved with renewable resources and related primary industries such as agriculture and fisheries, and that the objectives of such a review be to make sure that these agencies do not get involved in R&D activities on manufactured goods based on primary products, abandon or reduce certain programs which have a low Canadian priority, and contact out their mission-oriented basic research to universities or to the National Research Academy, and as much as possible of their development work to industry;
37.	P.590	2) ... That the Ministry for Science and Technology undertake a review, with the same objectives, of industrial R&D programs in laboratories operated by government departments and agencies for secondary and service industries as well as for mining and power utilities;
38.		3) ... That on March 31, 1973, these latter government laboratories be brought together in a new Crown company called the Canadian Industrial Laboratories Corporation (CILC) with a strong industrial representation on its board and committees and a growing industrial contribution to its financing and to be responsible to the Department of Industry, Trade and Commerce; and
39.		4) ... That pending the results of the proposed detailed review, a financial and manpower limit be imposed on intramural industrially-oriented R&D activities, commencing in fiscal year 1973-74.
40.	P.592	1) ... That the Ministry of State for Science and Technology be given responsibility for initiating the creation of new scientific and technical information and transfer systems and technological forecasting services in co-operation with the proposed National Research Academy and the Department of Industry, Trade and Commerce and in consultation with the communication industry;
41.	P.593	2) ... That the main operating responsibility for the collection, storage, and dissemination of scientific and technical documentation should be assigned to the proposed National Research Academy, and the operating responsibility for the collection, storage, and effective transfer of information and technological forecasts concerning the industrial innovative process should be assigned to the Department of Industry, Trade and Commerce, while enabling other government agencies to maintain their own systems according to their specific needs;
42.		3) ... That the Ministry of State for Science and Technology be responsible for the continuing review and evaluation and co-ordination of the various government agencies' scientific and technical information and technological forecasting activities; and

43.		4) . . . That all these activities be arranged so as to encourage the development of a Canadian information and forecasting industry to which the two ministries named above should give high priority.
44.	P.595	1) . . . That the Ministry of Science and Technology review all scholarship and pre-doctoral fellowship programs sponsored by the Canadian government in light of projected QSE requirements for the 1970s, mainly in the technological sectors, including social engineering and business management, and with the view of eliminating emerging surpluses in certain areas and scarcities in others; and
45.	P.596	2) . . . That the Ministry develop a program in co-operation with the Public Service Commission and the Treasury Board to facilitate the mobility of R&D personnel within the government and between universities, industry and public agencies, with special emphasis on transfers from government to industry.

A Science Policy for Canada: Volume 3—A Government Organization for the Seventies

Chapter 20: The Nature and Role of the Central Machinery for Canadian Science Policy

1.	P.661	. . . That the penultimate section of the terms of reference of the Minister of State for Science and Technology be changed to read as follows: His Excellency in Council is further pleased to specify that the Minister of State for Science and Technology shall, in relation to the formulation and development of the aforementioned policies, have such duties as may be assigned to him by law, and without limiting the generality of the foregoing, shall review and assess the formulation and development of advice by departments and agencies of the Government of Canada to the Governor in Council with regard to (a) the optimum investment in, and application of science and technology in pursuit of national objectives, (b) the organization of the scientific establishment in the public service of Canada, (c) the allocation of financial, personnel and other resources to Canadian scientific endeavours, and (d) the extent and nature of Canada's participation in international scientific activities and the co-ordination of related domestic activities.
2.	P.663	. . . That the Minister of State for Science and Technology be an ex-officio member of Treasury Board and of the Cabinet Committee on Priorities and Planning.
3.	P.665	. . . That an outside task force be set up to review the organization and structure of the Ministry of State for Science and Technology and to make recommendations in this respect in the light of its proposed new mandate.
4.	P.667	. . . That an Interministerial Committee for Science and Technology be established, under the chairmanship of the Minister of State for Science and Technology, to examine and approve general and specific science policies and scientific programs of departments and agencies and that the Minister's officials serve as the secretariat of the Committee.

5. P.672 1) ... That the name of the Science Council of Canada be changed to the Science and Engineering Council of Canada;

6. 2) ... That the council be composed of a full-time chairman and vice-chairman, one representing the physical sciences, the life sciences, and engineering, the other the social sciences and the humanities, and of twenty-eight other members chosen from outside the Public Service of Canada;

7. 3) ... That the ordinary members of the council be appointed after consultation with appropriate representative organizations, and on such a basis as to adequately represent the two main non-government R&D performance sectors, the main scientific and engineering disciplines including the social sciences and humanities, and the four broad regions of the country;

8. 4) ... That the terms of reference of the council be interpreted as covering the social sciences and the humanities; and

9. 5) ... That the council, in the exercise of its broad function as an impartial observer, adviser, and critic of the formulation and implementation of science policy, maintain close liaison with the representative organizations of the Canadian scientific and engineering community for the purpose of getting their considered views on the orientation and development of that policy.

Chapter 21: Re-Organization of Departments and Agencies

10. P.680 ... That individual departments and agencies implement the principle, put forward in the Rothschild report, that applied research and development be done on a customer-contractor basis in order to improve micro decisions regarding science and technology.

11. P.720 ... That the Department of Industry, Trade and Commerce set up a task force to investigate all factors having an important effect on the individual private inventor in Canada, to consider the kind of public assistance provided by other countries in this area, and the desirability of establishing a Canadian inventors council to assist private inventors and to act as their formal spokesman.

12. P.721 1) ... That the government institute a series of awards to be given to Canadian industrial units for meritorious technological innovation and to Canadians contributing significant inventions, to be called The Innovation Canada Award and the Invention Canada Award; and

13. P.722 2) ... That the Ministry of State for Science and Technology and the Department of Industry, Trade and Commerce jointly advise on the nature of the awards and on the criteria and process of selection.

14.	P.723	... That a deputy-minister of industry be appointed in the Department of Industry, Trade and Commerce as the senior official responsible for implementing a technological and industrial strategy and for administering its support services, and that a senior assistant deputy minister for technology and innovation be designated as soon as possible to serve eventually under the new deputy minister when appropriate legislation has been approved.
	Chapter 22: The Interfaces of Science Policy	
15.	P.732	... That an Interministerial Federal-Provincial Committee on Science and Technology be established to meet at least once a year before the federal annual estimates for scientific activities are finally approved and to be presided over by the Minister of State for Science and Technology.
16.	P.736	... That the name of the Institute for Research on Public Policy be changed to the Institute for Research on Social Policy and that the Federal-Provincial Ministerial Committee on Science and Technology proposed earlier approve its financing and its research priorities, provided that not more than twenty per cent of its budget be devoted to activities of its own choosing.
17.	P.744	... That the Royal Society of Canada, with the assistance of a special grant from the Ministry of State for Science and Technology, assume the overall responsibility for developing and maintaining relations with foreign private scientific and engineering bodies, in close co-operation with the International Branch of the Ministry and the specialized scientific and engineering associations existing in Canada.
18.	P.746	... That the Ministry of State for Science and Technology and the Department of Industry, Trade and Commerce develop a "marriage bureau" for those firms in Canada which are free to develop new products and services for the international market and that they develop mechanisms and services for expediting partnerships between these Canadian firms and complementary companies in other countries, including the sponsoring of industrial visits abroad.
19.	P.748	... That an appropriate standing committee of the Senate be authorized to review the annual overall science budget proposed by the government, to hold hearings for this purpose, and to prepare a report containing its comments, suggestions and recommendations.
20.	P.749	... That a group of parliamentarians from the Senate and the House of Commons be organized to study science policy matters and problems and opportunities raised by science and technology and that, in order to attain this objective, it be authorized, to form in due course a Canadian Association of Parliamentarians, Scientists and Engineers (CAPSE) in collaboration with representatives of scientific and engineering bodies.
21.	P.750	... That the group of Canadian parliamentarians proposed above be authorized to invite parliamentary delegations from OECD countries to a conference in Ottawa for the purpose of creating an Inter-parliamentary Association on Scientific Affairs.

22. P.756 1) ... That the Ministry of State for Science and Technology be mainly responsible for defining and co-ordinating the Canadian government's relations with private scientific and engineering societies, that the present activities carried out by NRC, the Canada Council, and similar agencies in the area of relations with such private bodies at the national and international level be phased out and that the funds allocated by these government agencies for this purpose be transferred to MOSST;

23. 2) ... That the Ministry formally recognize the Royal Society of Canada and the Association of the Scientific, Engineering and Technological Community of Canada (SCITEC) as the two main spokesmen of the Canadian scientific and engineering community in the areas of science for policy and policy for science respectively;

24. 3) ... That the new "make-or-buy" policy be applied in these two areas by all government departments and agencies, especially by MOSST and the Science Council, and that studies they require on these two topics be contracted out whenever desirable to the Royal Society and SCITEC;

25. 4) ... That the Ministry of State for Science and Technology make an adequate, annual, unconditional grant to these two national bodies—the amount to be determined after consultation with them—for the purpose of enabling them to maintain an efficient secretariat, to undertake a few studies on their own initiative, to hold periodic symposia, and to finance their publications;

26. P.757 5) ... That these arrangements be for the 1970s and be evaluated for review in 1980.

27. P.759 ... That a *Service international de terminologie scientifique et technique* (SITEST) be established by the Canadian government with appropriate international representation and operated as a Crown corporation.